THE

CARPET-DEALER'S GUIDE

A Manual of Practical Information

JOHN H. MACKE.

7 2 '03

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CARPET-DEALER'S GUIDE.

A

Manual of Practical Information

ON THE

ART OF MEASURING ROOMS AND CUTTING CARPETS,

INCLUDING

VARIOUS TOPICS OF INTEREST TO ALL CARPET-DEALERS.

BY JOHN H. MACKE.

WITH NUMEROUS PRACTICAL ILLUSTRATIONS.

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INTRODUCTION.

THIS work is designed to fill a long-felt want in the carpet trade. Great advancement is constantly being made in architecture, and in the construction of modern houses and apartments. The carpet-dealer should keep step with the architect, and, advancing in a corresponding degree, adapt his work to the times. Impressed with the importance of this fact, the writer has prepared the present work.

In the representative journals of the carpet industry, within the last few years, there have been published drawings and explanatory remarks on measuring and carpet-cutting that have attracted no little attention. Many wise suggestions have been made on this subject. Believing, however, that the illustrations so far published are capable of great improvement, it is proposed, in this work, to present a concise and practical system for measuring and cutting that will be regarded as a responsible guide by all who are identified with the carpet trade, and an advance on any work of the same character that has heretofore been published.

The object is to furnish a few of the most practical problems in plane geometry, not only to benefit the learner, but, it is hoped, to profit also those who

have had experience in the business. It is true that all the problems we have given may not apply to the immediate needs of the reader or dealer; still, a knowledge of the elementary principles of plane geometry will assist to develop the art of constructiveness, and be of decided practical use.

To many, the study of geometry may seem at first dry and fruitless; but, once understood, it becomes attractive, the advantage gained arouses the ambition, and a feeling of satisfaction is derived in knowing that you have the ability to accomplish what you are called to do without fear of failure. A person well equipped with all the facts and theories of his vocation can not be denied success.

The diagrams in this work are strictly based upon geometric principles. Examine them thoroughly, and you will be convinced that whoever attempts to cut and fit carpets without some such scientific rules for guidance labors at a great disadvantage. Those who are not familiar with the first principles of geometry should commit to memory at least the portion here given, if they desire to be skillful in their art. To be acquainted with these principles is to possess a knowledge that leads to economy and facility in the accomplishment of your work.

Study particularly the remarks and illustrations showing how and where the carpet must be cut to match. This is very important, especially to beginners, and to merchants who deal in carpets to a limited extent. The engravings in this depart-

ment simplify questions that are sometimes regarded as very perplexing.

This work will be found specially valuable, we believe, to any one who is about to learn a trade in which geometry is an underlying principle. He will find in its pages an otherwise dry and barren task made interesting and attractive. The problems, often accompanied by diagrams, are stated with such clearness and simplicity that the youth's attention is properly incited, and the study is a welcome one. Having acquired the principles thus taught, and become fitted for his business, his future labor will be attended with a feeling of personal pleasure, without which good results are seldom attained.

If you wish to acquire knowledge and skill as a carpet-dealer or workman, and to feel a satisfactory consciousness of your worth in either position, by all means become thoroughly acquainted with the examples laid before you in this book.

PART I.

GEOMETRICAL DEFINITIONS.

ELEMENTARY PROPERTIES OF STRAIGHT LINES, ANGLES, TRIANGLES, QUADRILATERALS, AND THE CIRCLE DEFINED AND ILLUSTRATED.

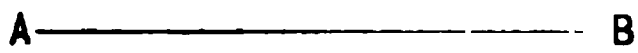
DEFINITIONS.

1. A POINT is mere position, without length, breadth, or thickness.

2. A LINE is length, without breadth or thickness.

3. A SURFACE consists of length and breadth, without thickness.

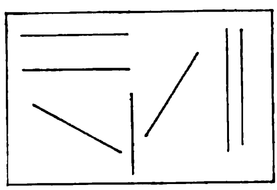
4. A STRAIGHT LINE is a line which has the *same directions* throughout its whole length; as the line A B.



5. A BROKEN LINE is composed of different straight lines; or, more properly speaking, it is a series of connected straight lines; as C D.

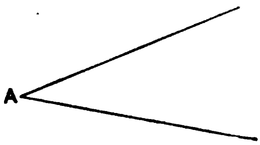
6. A CURVED LINE is one which is constantly *changing its direction*, no portion of it being straight; as the line E F.

7. A PLANE SURFACE, or simply a *plane*, is a surface in which a straight line will entirely lie between any two points.

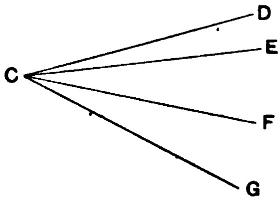


A *curved* surface is one no portion of which is plane.

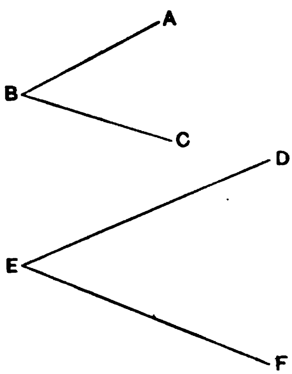
8. A PLANE ANGLE, or simply an *angle*, is when two straight lines meet each other; or it may be defined as the opening or divergence of two straight lines proceeding from the same point; as the angle A. The point A, in which the two lines meet, is called the *vertex*, and the two lines are called the *sides* of the angle.



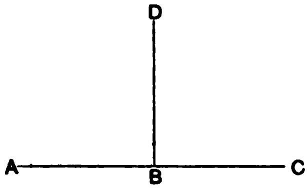
9. When two or more angles are formed at the same point, either of the angles may be designated by three letters; that is, by one letter on each of its sides, and one at its vertex; the letter at its vertex being always between the other two. Thus, the angle formed by the lines C D and C E is called the angle D C E or E C D; again, the lines C E and C F form the angles E C F or F C E.



10. The size of an angle depends upon the degree of separation of its sides, and not upon their length. Thus, the angles A B C and D E F are equal, because their sides separate equally, although the sides of the latter are longer than those of the former.

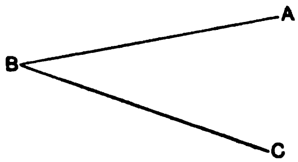


11. When one straight line meets another straight line, so as to make two adjacent angles equal to one another, each of these angles is called a *right angle*, and the first line is said to be *perpendicular* to the second. Thus, if the line B D meets the line A C in the point B, and making the angle A B D equal to the angle C B D, each of the angles is a *right angle*, and the line B D is *perpendicular* to A C. The parts A B and B C are termed *segments* of the line A C.

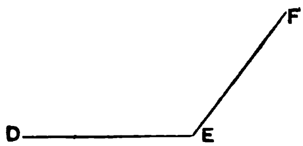


Two angles are said to be *adjacent* to each other when they have a common *vertex* and a common *side.*

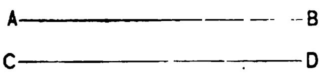
12. An ACUTE ANGLE is one which is less than a right angle; as the angle A B C.



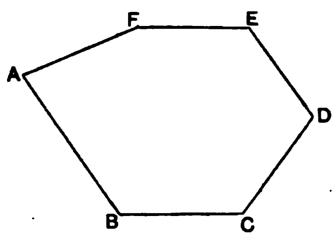
13. An OBTUSE ANGLE is one which is greater than a right angle; as the angle D E F.



14. PARALLEL straight lines are such as are in the same plane, and which, being produced ever so far both ways, do not meet; as A B and C D.

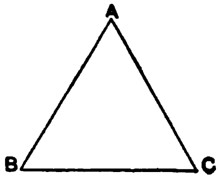


15. A POLYGON or rectilineal figure is a portion of a plane bounded by straight lines as A B C D E F. The

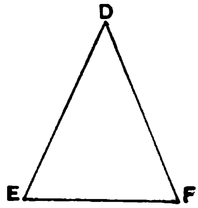


bounding-lines are called the sides of the polygon; all the sides together make up the *perimeter* of the polygon.

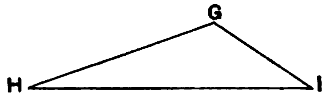
16. A TRIANGLE is a polygon of three sides. An *equilateral* triangle is one whose three sides are all equal to one another; as the triangle A B C.



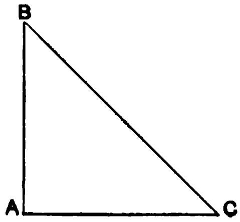
17. An ISOSCELES TRIANGLE is one which has only two of its sides equal; as the triangle D E F.



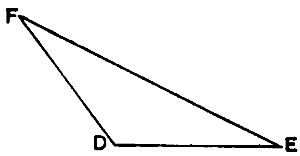
18. A SCALENE TRIANGLE is one which has no two of its sides equal; as the triangle G H I.



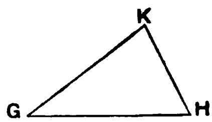
19. A RIGHT-ANGLED TRIANGLE is one which has a right angle; as the triangle B A C, which is right-angled at A. The side B C is called the *hypothenuse;* A C and A B may be called the perpendicular sides, but are usually termed the base and perpendicular.



20. An OBTUSE-ANGLED TRIANGLE is one which has an obtuse angle; as the triangle F D E.



21. An ACUTE-ANGLED TRIANGLE is one which has three acute angles; as the triangle G H K.

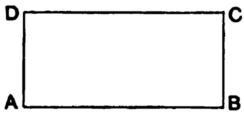


QUADRILATERALS.

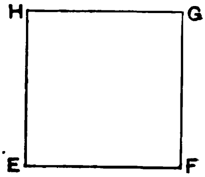
22. A QUADRILATERAL is a polygon of *four sides.*

23. A PARALLELOGRAM is a quadrilateral whose opposite sides are *parallel.*

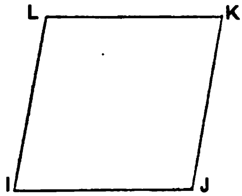
24. A RECTANGLE is a parallelogram whose angles are all *right angles;* as the figure A B C D.



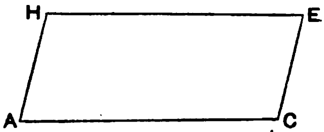
25. A SQUARE is a parallelogram which has all its sides equal, and all its angles *right angles;* as figure E F G H.



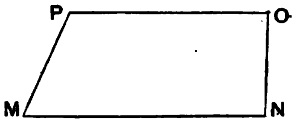
26. A RHOMBUS is a parallelogram whose sides are all equal in length, but its angles are not right angles; as the figure I J K L.



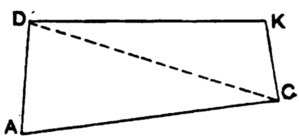
27. A RHOMBOID is a parallelogram whose opposite sides only are equal, but its angles are not right angles; as the figure A C E H.



28. A TRAPEZOID is a quadrilateral which has only two of its opposite sides parallel; as the figure M N O P.



29. A TRAPEZIUM is a quadrilateral which has neither pair of its opposite sides parallel; as the figure A C K D.



30. The straight line D C in the figure A C K D is called a *diagonal.*

PENTAGONS, HEXAGONS, ETC.

31. A PENTAGON is a polygon of five sides.

32. A HEXAGON is a polygon of six sides.

33. A HEPTAGON is a polygon of seven sides.

34. An OCTAGON is a polygon of eight sides.

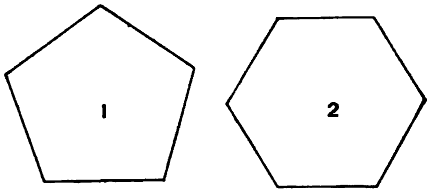
35. A NONAGON is a polygon of nine sides.

36. A DECAGON is a polygon of ten sides.

37. An UNDECAGON is a polygon of eleven sides.

38. A DODECAGON is a polygon of twelve sides, etc.

39. A REGULAR POLYGON is one which is both *equilateral* and *equiangular*; that is, all its sides are equal and all its angles are equal. Figure 1 represents a regular *pentagon*. Figure 2 a regular *hexagon*.

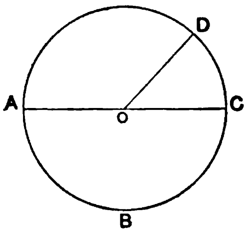


ELEMENTARY PROPERTIES OF THE CIRCLE.

1. A CIRCLE is a plane surface bounded by a curved line called the *circumference*.

2. The CENTER of a circle is a point within, which is equally distant from every point in the circumference.

3. A DIAMETER of a circle is a straight line passing through the center, and terminating both ways in the circumference.



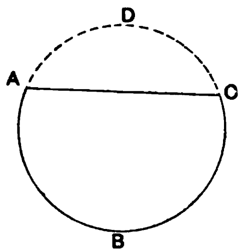
4. A RADIUS of a circle is any straight line drawn from the center to the circumference.

In the circle A B C D, the point *o* is the *center*; the straight line A C is a *diameter*, and *o* D is termed a *radius*.

5. An ARC of a circle is any portion of the circumference.

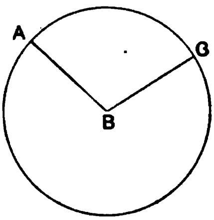
6. A CHORD is a straight line joining any two points in a circumference, but not passing through the center.

7. A SEGMENT of a circle is the portion of a circle included between the chord and its arc; a segment which is one-half of the circle is called a *semicircle*.

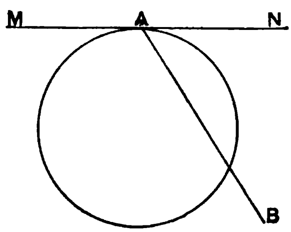


In the circle A B C D, the curve A D C is an *arc*, the straight line A C is a *chord*, and the space inclosed between the chord A C and the arc A D C is a *segment*.

8. A SECTOR of a circle is the part of a circle included between an arc and the two radii drawn to the extremities of the arc; as the figure A B C.



9. A TANGENT to a circle is a straight line drawn in the same plane so as to meet the circumference without cutting it when produced.



10. A SECANT to a circle is a straight line which terminates in the circumference on one side and cuts it on the other, thus lying partly within and partly

without the circle. MN is a *tangent*, and AB is a *secant*.

EXPLANATION OF THE SIGNS.

For the sake of brevity, the following principal signs are used in this work:

$$=,\ +,\ -,\ \times,\ \div,\ (\ ),\ \surd.$$

The sign $=$ is read *equal to*. It denotes that the quantities between which it is placed are equal to each other. Thus, $A = B$ denotes that A is equal to B.

The sign $+$ is read *plus*, and indicates *addition*. Thus, $A + B$ denotes that B is to be added to A.

The sign $-$ is read *minus*, and indicates *subtraction*. Thus, $A - B$ denotes that B is to be subtracted from A.

The sign $\times$ is read *times*, or *multiplied by*, and denotes multiplication. Thus, $A \times B$ denotes that A is to be multiplied by B.

The sign $\div$ is read *divided by*, and indicates division. Thus, $A \div B$, or $\frac{A}{B}$ means that A is to be divided by B.

A *parenthesis* ( ) indicates that several quantities are to be subjected to the same operation. Thus, $2\,(A - B)$ means that $A - B$ is to be multiplied by 2.

The sign $\surd$ is called the *radical sign*. When placed before a quantity it indicates that its root is to be extracted. Thus, $\sqrt{A \times B}$ denotes the square root of the product of A and B.

PRACTICAL GEOMETRICAL PROBLEMS.

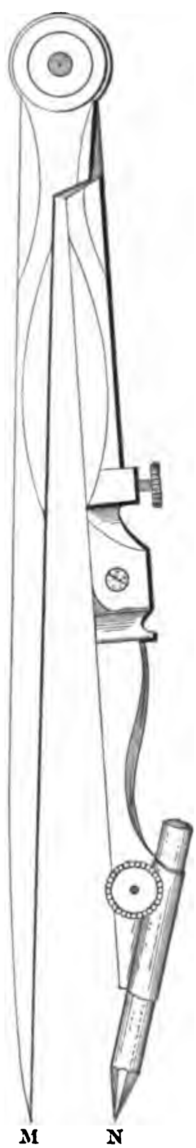
NOTE.—For the benefit of those who are not conversant with the use and application of the dividers (or compasses, as they are sometimes called) we will give here a brief sketch, showing how the dividers are applied in the various problems.

Thus, the description in Section 1, Problem 1, signifies that you take the dividers, and, opening them greater than one-half of the line A B, and placing the sharp point M of the dividers firmly in the point A of the straight line A B, with the pencil point N describe a part of a circle, or, more properly speaking, an arc of a circle.

Now, removing the dividers, and being careful to keep them open just the same, place the sharp point M in B, and with the pencil-point N describe another part of a circle, intersecting the former circle in the points *e* and *s*. Then through these intersections, with a ruler, draw the straight line C D.

Suppose we again place the dividers in A, and complete the circle; it is evident that the point A will be the center of the circle, and from the point A to any point in the circumference—that is, the distance from the sharp point M of the dividers to the pencil-point describing the circle — is termed a radius. Hence the expression, "From the point A, as a center, with any convenient radius, describe an arc," etc.

The reader should be careful to note the distinction between the expressions, "with any convenient radius" and "with a radius equal to;" the former meaning that the dividers can be open to any suitable size consistent



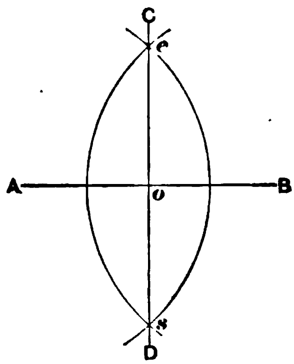
with the problem, and the latter that the dividers are to be open to a size that may be designated in the problem.

PROBLEM 1.

To bisect a given straight line; that is, to divide it into two equal parts.

Let A B be the given line that is required to be bisected.

1. From the point A, as a center, with any convenient radius greater than half of the straight line A B, describe an arc of a circle; and from the point B, with the same radius, describe another arc intersecting each other in the points *e* and *s*.



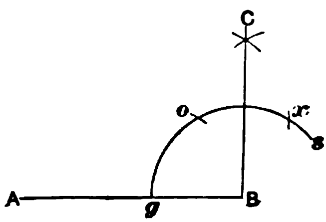
2. Through the points of intersection at *e* and *s* draw the straight line C D, and it will bisect or divide the straight line A B in the point *o*, as required.

NOTE.—The bisecting line C or C D is perpendicular or right-angled to A B.

PROBLEM 2.

To construct a right angle.

Let A B be the given straight line upon which it is required to construct a right angle at the point B.



1. From the point B, as a center, with any convenient radius, describe the arc *g s*.

2. From the point g, with the same radius, cut the arc in o; and from the point o, with the same radius, cut it again in x.

3. From the points o and x, as centers, with the same or greater radius, describe the arcs intersecting each other in the point C.

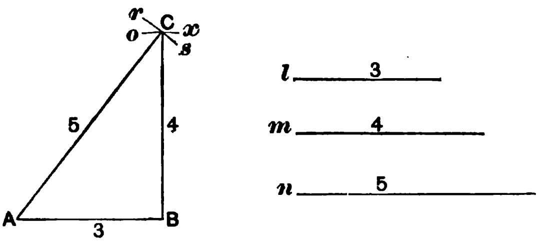
4. From the point B, and through the intersection at C, draw the straight line C B; then will A B C be a right angle, and it has been constructed upon the given straight line A B as required.

NOTE.—This problem, and Problem 3, is the first important step necessary for reproducing and marking out rectangular rooms and spaces. As this is one of the first requisites for carpet upholsterers, and as the solution is so simple, it will be well for those not conversant with it to study it and commit it to memory.

PROBLEM 3.

To construct a right angle by a different method.

Let $l\,m\,n$ be the given sides; and to measure 3, 4, and 5 feet respectively, it is required to construct the right angle A B C.



1. Draw the straight line A B, equal to the given distance of 3 feet.

2. From the point B, as a center, with a radius equal to the given distance 4 feet, describe the arc $o\,x$.

3. From the point A, as a center, with a radius equal to the given distance 5 feet, describe the arc $r\,s$, cutting the former in C; through the intersection at

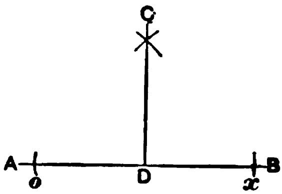
C draw the straight line B C; then will A B C be a right angle, and has been constructed as required.

NOTE.—The above method of describing a right angle is most generally used in carpentry for marking out rooms, spaces, etc. When greater dimensions are required some multiple of the above given numbers are used; thus, 6, 8, 10, or 9, 12, 15; again 12, 16, 20; increasing each term, as the case requires. It is proper to remark that this proposition is limited to triangles whose sides have the same ratio to each other as the sides of the triangle A B C; namely, 3, 4, 5.

PROBLEM 4.

To draw a line perpendicular to a given line; that is, from a point on A B.

Let A B be the given line, and D the point from which it is required to draw D C perpendicular or at right angles to A B.



1. From the point D, as a center, with any convenient radius, cut the given line A B in the points *o* and *x*.

2. From the points *o* and *x*, as centers, with any convenient radius greater than D *o* or D *x*, describe arcs intersecting each other in C.

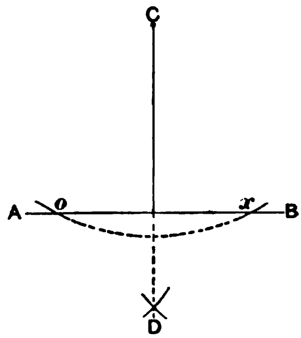
3. Through this intersection, to the given point D, draw the straight line C D, which will be perpendicular to and at right angle with A B, as required.

PROBLEM 5.

From a given point without a straight line, to draw a perpendicular to that line.

Let C be the given point, and A B the given straight line, it is required to draw from the point C a perpendicular to A B.

1. From the point C, as a center, with any convenient radius greater than the distance A B, describe an arc cutting the straight line A B in the points *o* and *x*.



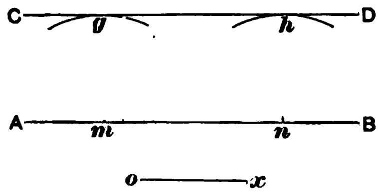
2. From the points *o* and *x*, as centers, with any convenient radius greater than the half of *o x*, describe arcs intersecting each other in D.

3. From the point C, and through the intersection D, draw the straight line C D, and it will be perpendicular to A B as required.

PROBLEM 6.

To draw a straight line parallel to a given straight line at a given distance from it.

Let A B be the given straight line, and *o x* the given distance from it.



1. In the given line A B take any two points, as *m n*; then from these points as centers, with a radius equal to the given distance *o x*, describe the arcs *g* and *h* over A B.

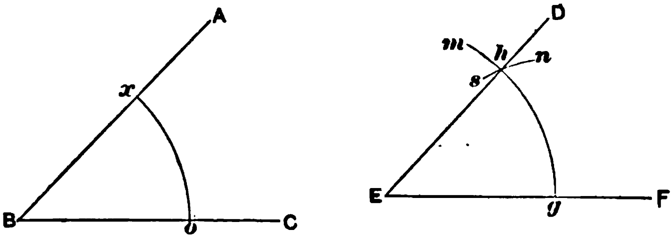
2. Touching the arcs *g* and *h* draw the straight line C D, which will be parallel with A B as required.

PROBLEM 7.

To construct an angle at a point in a given straight line equal to a given angle.

Let A B C be the given angle, and E F the given straight line, it is required to make an angle at the

point E in the given straight line E F equal to A B C.



1. From the points B and E, as centers with any convenient radius, describe the arcs *o x* and *g m*.

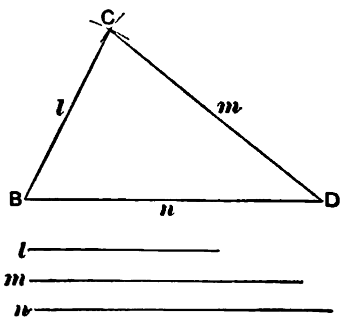
2. From the point *g*, with a radius equal to the distance *o x*, describe the arc *s n*, and cutting the former in the point *h*.

3. From the point E, through the intersection at *h*, draw the straight line E D, and the angle D E F will be equal to the angle A B C, and it has been constructed at the point E, as required.

PROBLEM 8.

To construct a triangle, the three sides being given.

Let *l m n* be the three given sides.



1. Draw the straight line B D equal to the given side *n*.

2. From the point B as a center, with a radius equal to the given side *l*, describe an arc at C.

3. From the point D as a center, with a radius equal to the given side *m*, describe an arc, cutting the former in the point C.

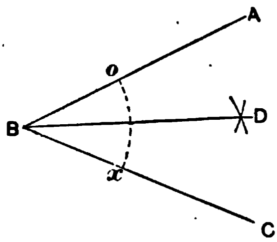
4. Through this intersection draw B C and D C; then will B C D be the required triangle.

NOTE.—The triangle is the most simple of all rectilineal figures, and yet the most important, as by this geometrical figure the angles and dimensions of all rooms, halls, etc., can be accurately determined.

PROBLEM 9.

To bisect any angle; that is, to divide it into two equal angles.

Let A B C be the given angle which is required to be bisected.



1. From the point B as a center, with any convenient radius, describe an arc cutting B A and B C in the points *o* and *x*.

2. From the points *o* and *x*, with the same or greater radius, describe arcs intersecting each other in D.

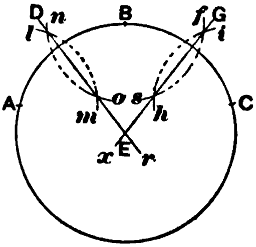
3. From the point B, through the intersection D, draw the straight line B D, which will bisect the angle A B C, as required.

NOTE.—This problem can be very usefully applied by the "fitter" in making miters around fire-place and corners of bay windows, etc. *Illustration:* Take the angles at E and L, Diagram 14, or the angles at E and H, Diagram 13; in order to make the miter at these points bisect the angles as described above, draw the chalk-line and fit the border to this line. The ordinary way of making miters is to turn back each end of the border, and then to draw either piece, as the case may be, to make the stripes meet; by this method it is liable to draw the miter out of a straight line, especially at the corners of fire-place and bay window, particularly if it is a moquette. Hence, by applying the above problem, this may be obviated.

PROBLEM 10.

To find the center of a circle.

Let A B C be the given circle of which it is required to find the center.



1. Take any three points, as A B C in the circumference; then from the point A, as a center, with any convenient radius greater than half the distance A B, describe the arc *l m*.

2. From the point B, as a center, with the same radius, describe the arc *n o;* through the points of intersection draw the straight line D *r*.

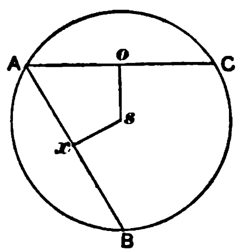
3. From B as a center, with a radius greater than half the distance from B to C, describe the arc *f s*.

4. From C as a center, with the same radius, describe the arc *i h;* through the points of intersection draw the straight line G *x;* and the point E, where the straight lines D *r* and G *x* intersect each other, is the center of the circle as required.

PROBLEM 11.

To find the center of a circle by a different construction.

Let A B C be the given circle.



1. Take any three points, as A B and C on the circumference, and draw the chords A B and A C; bisect these chords in the points *o* and *x*, as in Problem 1.

2. Draw the perpendiculars from the points *o*

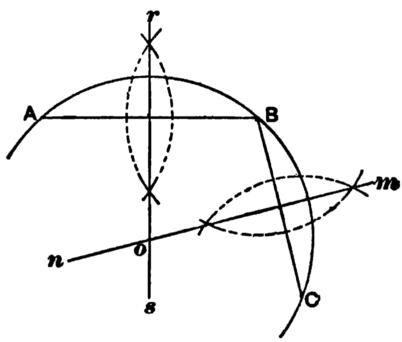
and *x*, and their intersection will be the center of the circle.

NOTE.—By the same construction may be found the center from which to describe a circle through three given points, as will be demonstrated in Problem 12. A triangle is circumscribed by the same method.

PROBLEM 12.

To describe the circumference of a circle through three given points, not in a straight line.

Let A B C be the three given points through which it is required to draw the circumference.



1. Join the points A B and C by the straight lines A B and B C.

2. Bisect the straight lines A B and B C, as in Problem 1; draw the perpendiculars *r s* and *m n;* the point *o* in which the perpendiculars intersect each other is the center.

3. From the point *o* as a center, with the distance *o* A as a radius, describe the circumference, which will pass through the three given points A B and C, as required.

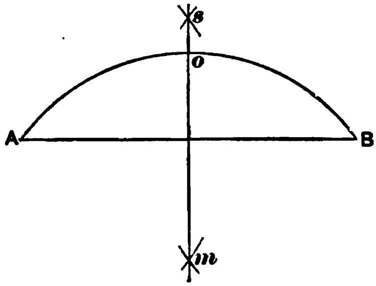
NOTE.—By this same method, circular windows, as in Diagrams 12 and 16, or any segment of a circle, as in Diagrams 17 and 18, can be described.

PROBLEM 13.

To bisect a given arc of a circle.

Let A B be the given arc which it is required to bisect; that is, to cut it into two equal parts.

1. Draw the chord A B, then from the points A and B as centers, with any convenient radius greater than half the chord, describe arcs intersecting each other in the points *s* and *m*.



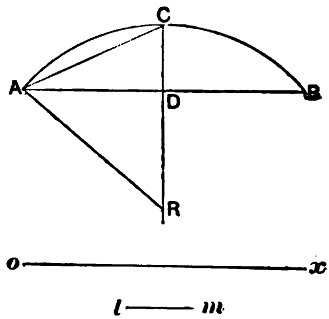
2. Through these intersections draw the straight line *m s*; then will this straight line be perpendicular to the given arc A B, and will cut it in the point *o* into two equal arcs as required.

PROBLEM 14.

To describe the arc of a circle when the chord and the height or versed sine are given.

Let *o x* be the given chord and *l m* the given height or versed sine.

1. Draw the straight line A B equal to the given chord *o x*, and bisect it in D (as in Problem 1), and draw the perpendicular C R of indefinite length both ways.



2. From the point D, on the straight line A B, make D C equal to the given height or versed sine *l m*.

3. Draw the straight line A C, and at the point A make the angle C A R equal to the angle A C R (as in Problem 7), and the point R, where the side A R

cuts the perpendicular C R, is the center of the circle, and from the point R with a radius equal to R A or R B, describe the arc A C B, then the arc A C B has its chord equal to the given chord *o x* and its height or versed sine D C equal to the height *l m* as required.

NOTE.—The rule for finding the radius when the chord and versed sine are given, is to divide the sum of the squares of half the chord and versed sine by twice the length of the versed sine; the quotient is the radius; that is, by referring to the above diagram $\frac{\frac{1}{2}(AB)^2 + DC^2}{2DC} = R$, or if the chord $AB = 8$ and the height of the versed sine $= 2$, then would $\frac{1}{2}\ 8 = 4$; $4^2 + 2^2 = 4 \times 4 = 16$; $2 \times 2 = 4$; $16 + 4 = 20$; divide this by twice the height of the versed sine, which is $2 \times 2 = 4$, then $20 \div 4 = 5$; 5.0 the length of the radius.

EXAMPLES.

The opening across the circular window in Diagram 21 is 10.6, the depth 2.6; what is the length of the radius?

According to the above rule $\frac{1}{2}(10.6) = 5.25$; $5.25^2 + 2.5^2 = 33.8125 \div 5 = 6.7625 = 6.9\frac{3}{20}$ the length of the radius, which will be found to be true when reproducing the room.

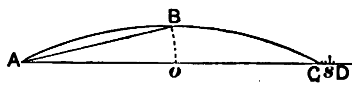
What is the length of the radius describing the arc A G F in Diagram 17, the chord of which is 14.10, and the versed sine 3.0?

PROBLEM 15.

To find the length of a given arc on a straight line.

Let it be required to find a straight line equal in length to the given arc A B C.

1. Draw the chord A C and produce it beyond C.



2. Bisect the arc in the point B, as in Problem 13; and from the point A,

with a radius equal to A B, cut the chord A C in the point *o*; and from the point *o* with the same radius cut the produced part in the point *s*.

3. Divide C *s* into three equal parts, and set off one part to D; then will the straight line A D be equal in length to the given arc A B C (nearly), as required.

NOTE.—A straight line has not, so far, been drawn equal to a curved line; that is, it has never been demonstrated. The above demonstration is a very close approximation. The arithmetical rule for finding the length of an arc is, from 8 times the chord of half the arc to deduct the chord of the whole arc, and the ⅓ part of the remainder will be the length of the arc required; that is, by referring to the above diagram $\frac{8\,AB - AC}{3} =$ A D. Thus, let A B = 4, A C = 7; then, according to the above rule, $8 \times 4 = 32$; $32 - 7 = 25$; $25 \div 3 = 8.33$, or 8.4, the length of A D, which is the length of the whole arc A B C (nearly).

EXAMPLES.

What is the length of the arc of circle A G F, Diagram 17?

According to the above rule, 8×8.0, the distance from A to G, $= 64.0$; from this sum deduct the distance A F; $64.0 - 14.10 = 49.2$; divide this sum by 3; $49.2 \div 3 = 16.4\frac{2}{3}$, which is a very close approximation for all practical purposes.

What is the length of the arc A G F, Diagram 18? of Diagram 21?

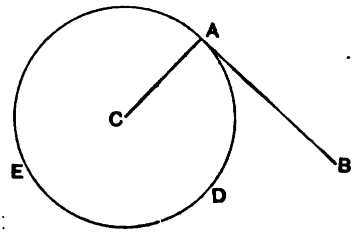
PROBLEM 16.

To draw a tangent to a given circle from a given point in its circumference.

Let A E D be the given circle, and A the given point in its circumference.

1. Find the center C of the given circle (as in

Problem 10), then from the given point A, to the center C, draw the straight line A C.

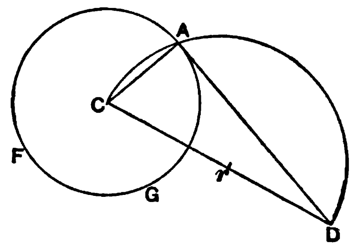


2. From the point A, draw the straight line A B perpendicular or at right angle to A C (as in Problem 2); then will A B be a tangent to the given circle A E D, as required.

PROBLEM 17.

To draw a tangent to a given circle from a given point without it.

Let A F G be the given circle, and D the given point without it.



1. Find the center C of the given circle (as in Problem 10); then, from the given point D to the center C, draw the straight line C D; bisect C D (as in Problem 1) in the point *r*; then from the point *r*, with a radius equal to *r* C or *r* D, describe the semicircle C A D, cutting the given circle A F G in the point A.

2. From the point D, and through the point of intersection A, draw the straight line D A; then will D A be a tangent to the given arc A F G, as required.

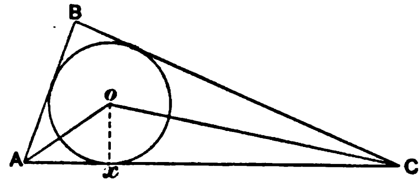
NOTE.—A tangent to a circle is perpendicular or at right angles to the radius, drawn to the point of contact with the circumference.

PROBLEM 18.

To describe a circle in any triangle.

Let A B C be the given triangle in which it is required to describe a circle touching all its sides.

1. Bisect any two angles (as in Problem 9), as the angles A and C, by the straight lines A *o* and C *o* intersecting each other in *o*.

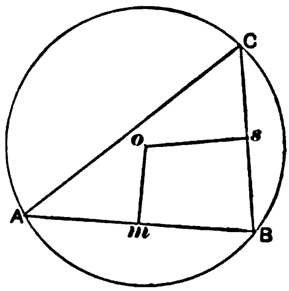


2. From *o* let fall the perpendicular *o x*; then from *o* as a center, with a radius equal to the perpendicular *o x*, describe a circle, and its circumference will touch each side of the triangle, as required.

PROBLEM 19.

To describe a circle about a given triangle.

Let A B C be the given triangle, it is required to describe a circle about it.



1. Bisect any two sides, as A B and B C, by the perpendiculars *m o* and *s o* intersecting each other in the point *o*; this point will be the center of the circle.

2. From the center *o*, with a radius equal to *o* A, *o* B or *o* C describe the circle, and it will pass through all the angular points of the triangle, as required.

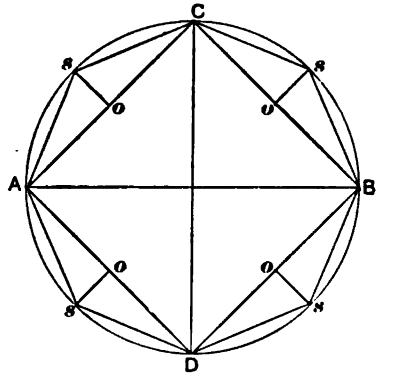
PROBLEM 20.

In a given circle to describe a square and an octagon.

Let A B C D be the given circle in which it is required to inscribe a square and an octagon.

1. Draw the two diameters A B and C D perpendicular to each other.

2. From the points A D B C draw the straight lines A D, D B, B C, and C A; thus forming the sides of the square, as was required.



3. To construct the *octagon;* bisect the straight lines A D, D B, B C, and C A (as in Problem 1) in the points *o*.

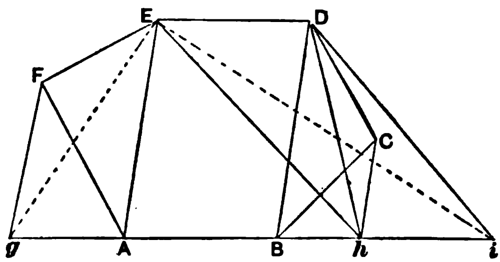
4. From the points *o* draw perpendiculars to the circumference of the circle at the points *s;* join A *s*, *s* D, D *s*, *s* B, etc., thus forming the sides of the inscribed octagon, as required.

PROBLEM 21.

To construct a triangle which shall be equivalent to a given polygon.

Let A B C D E F be the given polygon which it is required to reduce to an equivalent triangle.

1. Produce any side, as A B, indefinitely both ways.



2. Draw the straight line D B, and the straight line C *h*, parallel to it; also draw the straight line D *h;* now consider the triangle B C D cut off from the polygon and replaced by B *h* D; the magnitude of the polygon will not be changed, since B C D and B *h* D have the same

base B D, and the same altitude, as their vertices lie in C *h* parallel to D B.

3. Draw the straight line E *h*, and the straight line D *i* parallel to it; thus cutting off the triangle E *h* D, and replacing it by its equivalent E *h i* by drawing the straight line E *i*.

4. Draw E A and F *g* parallel to it; then draw E *g*, thus replacing E A F by its equivalent E *g* A; therefore *g* E *i* is equivalent to the given polygon A B C D E F.

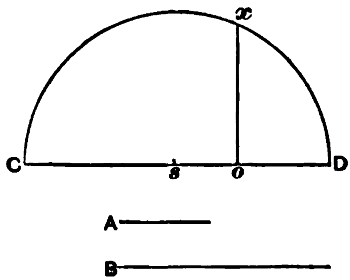
It is evident that if the given polygon had a greater number of sides, it would only require a greater number of like transformations to obtain an equivalent triangle.

PROBLEM 22.

To find a mean proportional between two given lines.

Let A and B be the two given lines, it is required to find a third line which shall be a mean proportional between them.

1. Draw the straight line C D equal to A and B, making C *o* equal to B, and *o* D equal to A.



2. Bisect the straight line C D (as in Problem 1) in the point *s*, and describe the semicircle C *x* D.

3. From the point *o* draw the perpendicular *o x*; then *o x* is the mean proportional required.

NOTE.—By substituting numbers for the lines A and B, let B equal 9, and A equal 4, then the mean proportional $o\,x$ will be 6; for $9 \times 4 = 36$, $\sqrt{36} = 6$, which is the mean proportional between 9 and 4, as in the following proportion 9 : 6 :: 6 : 4.

EXAMPLE.

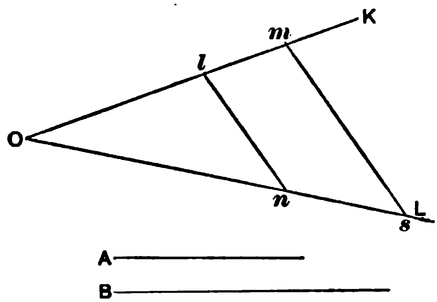
A rectangle which is 16 feet by 9 feet, let it be required to construct a square which shall be equal in area to the given rectangle.

Draw C D = 25, making C o = 16, and o D = 9; bisect this line, then describe the semicircle, and erect the perpendicular $o\,x$ from the point o; then will $o\,x = 12$. Then will 12 feet be the area of the required square, as in the following proportion, 16 : 12 :: 12 : 9.

PROBLEM 23.

To find a third proportional between two given lines.

Let A and B be two given lines, and let it be required to find a third line which shall have the same ratio to B, which B has to A.



1. Draw the two straight lines O K and O L, forming any angle with each other.

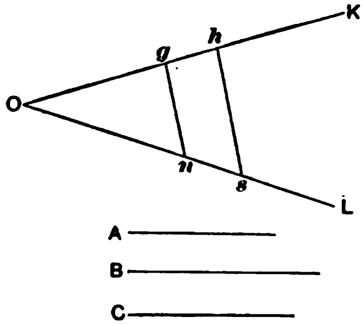
2. On O K lay off O l = A, and O m = B; then on O L lay off O n = B; join $l\,n$, and from the point m, draw $m\,s$ parallel to $l\,n$; the line O s is the third proportional required, having the same ratio to B, which B has to A in the following analogy:

O l : O m :: O n : O s; or,

A : B :: B : C, let A = 6; B = 8, then will C = $10\frac{2}{3}$; thus, 6 : 8 :: 8 : $10\frac{2}{3}$.

PROBLEM 24.

To find a fourth proportional to three given lines.



Let A B and C be three given lines, it is required to find a line which shall be a fourth proportional to them, and having the same ratio to C which B has to A.

1. Draw two indefinite straight lines, O K and O L, forming any angle with each other.

2. On O K lay off O g = A, and O h = B; then on O L lay off O n = C; join $g\,n$, and from the point h draw $h\,s$ parallel to $g\,n$; the line O s is the fourth proportional required, having the same ratio to the third term C, which B has to A. Thus, calling O s, D, the proportion is

$$Og : Oh :: On : Os; \text{ or,}$$
$$A : B :: C : D.$$

By assigning numbers to the above, let the straight line A = 6, B = 8, C = 7, then will D = $9\frac{1}{3}$ as in the following analogy:

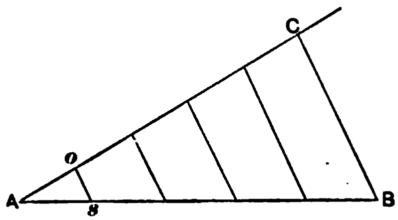
$$6 : 8 :: 7 : 9\tfrac{1}{3}.$$

In this method of finding a proportional, care must be taken in laying off the *first* and *second* terms on the *same* line as O K, and the *third* on the other line as O L.

PROBLEM 25.

To divide a given straight line into any number of equal parts.

Let A B be the given straight line which is required to be divided into any number of equal parts—say five.



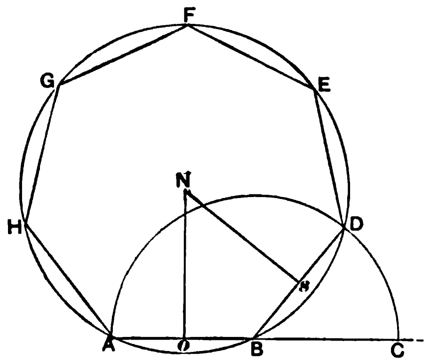
1. From the point A draw the indefinite straight line A C, forming any angle with A B.

2. On A C take any point as *o*, and set off A *o* five times on A C; join C B, and from *o* draw *o s* parallel to C B; then will A *s* be the $\frac{1}{5}$ part of A B, and when it is set off five times on A B, the latter will be divided into five equal parts as required.

PROBLEM 26.

To construct a polygon of any number of sides on a given straight line.

Let A B be the given line, and let it be required to construct a regular heptagon upon it.



1. Produce A B to C, making B C equal to A B; from the point B, with a radius equal to B A or B C, describe the semicircle A D C.

2. Divide the semicircle into *half* the number of parts that the required polygon is to have sides, beginning from the point C. Then, from the point B to the first

division D, in the semicircle A D C, draw the straight line B D; then will A B, B D, be the two sides of the required polygon, and A B D the included angle.

3. Bisect the two sides A B and B D by perpendiculars in the points *o* and *s* (as in Problem 1), and which will intersect each other in the point N. The point N will be the center of the proposed polygon.

4. From the center N, with a radius equal to N A or N B, describe the circle A B D E F G and H. Then, with a distance equal to the given side A B or B D, from the point D, cut the circumference in the points E F G and H.

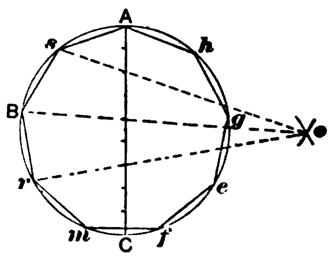
Join the several points by straight lines, and the figure thus formed will be a regular heptagon, and has been constructed upon the straight line A B, as required.

NOTE.—The above construction is a very close approximation.

PROBLEM 27.

To construct a regular polygon of any number of sides within a given circle.

Let A B C be the given circle in which it is required to construct any regular polygon; say a nonagon.



1. Draw the diameter A C, and divide it into nine equal parts.

2. From the points A and C as centers, and with a radius equal to the diameter A C, describe intersecting arcs in the point *o*.

3. From the point *o*, and through the second division on the diameter A C, draw the straight line *o s*, cutting the given circle in the circumference in the point *s*. The intercepted arc A *s* is the $\frac{1}{9}$ part of the circumference of the given circle; then join A *s*.

4. From the point *s*, and with the distance equal to *s* A, cut the circumference successively in the points B, *r*, *m*, *f*, *e*, *g*, and *h;* join the several points by straight lines; then will this figure form a nonagon, as required.

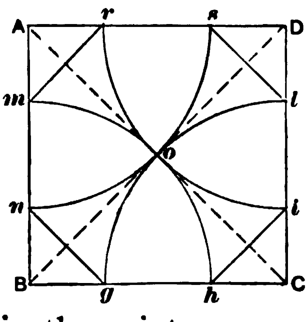
NOTE.—A polygon of any number of sides may be constructed in like manner, as shown above, within a given circle, taking care to divide the diameter into as many equal parts as the proposed polygon has sides. By drawing a line from the point *o* through the second division on the diameter to the circumference, the chord of the intercepted arc will in all cases be the side of the required polygon.

The above construction is a very close approximation.

PROBLEM 28.

To form a regular octagon by truncating the angles of a given square.

Let A B C D be the given square in which it is required to form a regular octagon by truncating its angles.



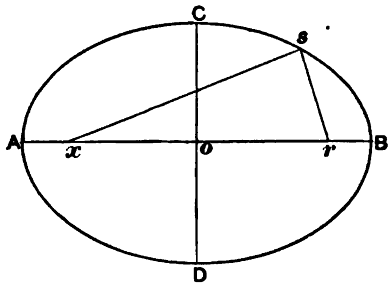
1. Draw the diagonals A C and B D, cutting each other in *o;* then from the points A B C and D, and with a radius equal to A *o*, describe arcs of circles, cutting the sides of the square in the points *m*, *n*, *g*, *h*, *i*, *l*, *s*, and *r*.

2. Join the various points by straight lines, and the figure thus formed will be a regular octagon, and has been constructed as required.

THE ELLIPSE.

The ELLIPSE is a plane figure bounded by a curved line of unequal diameter; and the sum of two straight lines drawn from two fixed points within the figure to a point in any part of the circumference, is equal to a straight line drawn through the same two points and terminated both ways by the curve.

A B C D is an ellipse; the points *x* and *r* are called the *foci* of the ellipse, and the two lines *r s* and *x s*, drawn from the points *x* and *r* to any point in the circumference, as *s*, are together equal to A B.



The middle point *o* of the straight line which joins the two foci is the center of the ellipse, and the distance *o x* from the center to either focus is the *eccentricity*.

The diameter A B, which passes through the two foci, is called the transverse axis; and the diameter C D, which is drawn through the center and perpendicular to the transverse axis, is called the conjugate axis.

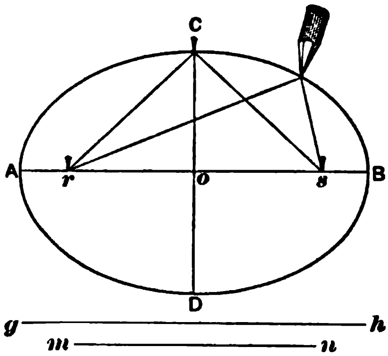
The transverse and conjugate axes are also termed *major* and *minor* axes.

PROBLEM 29.

To describe an ellipse.

Let it be required to describe an ellipse, the transverse and conjugate axes being given, and let *g h* be a line equal to the transverse axis, and *m n* equal to the conjugate axis.

1. Draw the straight line A B equal to the given line *g h*, and bisect it in the point *o* (as in Problem 1).



2. Through the point *o* draw the straight line C D equal to the given line *m n*, making D *o* equal to C *o*.

3. From the point C, with a radius equal to half the transverse diameter A B, cut the transverse diameter in the points *r* and *s*; these points are the foci of the ellipse.

4. Place a pin or tack in the points *r s* and C, and around them tie an inelastic cord; then remove the pin or tack at C, and in its place put a pencil, as shown in the above figure, and, pressing gently on the cord to maintain its proper tension, proceed to trace the curve by a continuous movement of the pencil along the cord to the place of beginning.

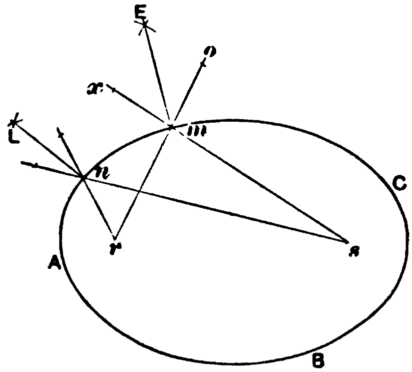
PROBLEM 30.

To draw the joints or perpendiculars in an elliptic curve.

Let A B C be the given ellipse, and let *m n* be given points on the circumference; it is required to

draw lines from these points which shall be perpendicular to the curve.

1. Find the focal points *r s* of the given ellipse (as in Problem 29), and from these points, through the given point *m*, draw the straight lines *r o* and *s x*, cutting each other in *m*.



2. Bisect the angle *x m o* (as in Problem 9); the line E *m* will be the line of the joint, and is perpendicular to the elliptic curve; and in the same manner the perpendicular L *n* is drawn from the given point *n*.

The interior angle *r m s* or *s n r* may be bisected by producing the straight line through the curve, and the result will be the same.

After describing the ellipse, the various points where the joints or miters are to occur should be located on the outside of the circumference; then from the focal points draw straight lines to each and every point on the circumference, and bisect each angle by straight lines; then will these be the proper joint lines for the border.

It is not necessary to produce the straight lines drawn from the focal points beyond the circumference; let them end in the circumference where they intersect each other, and bisect the interior angle.

MENSURATION OF PLANE SURFACES.

TABLE OF LINEAR MEASURES.

12 inches	make	1 foot.
3 feet	"	1 yard.
5½ yards	"	1 rod, or pole.
320 rods, or 5,280 feet	"	1 mile.

The area of a square is found by multiplying a *side* of the square by itself; that is, by *squaring* one of its sides; hence, there results the following:

TABLE OF SQUARE MEASURES.

144 square inches	make	1 square foot.
9 square feet	"	1 sqare yard.
30¼ square yards	"	1 perch, or square rod.
40 perches	"	1 rood.
4 roods	"	1 acre.
640 acres	"	1 square mile.

To find the area of a parallelogram.

Multiply the *base* by the altitude in the same denomination of units; the product will be the area in *square units*.

Example. Find the number of square yards in a parallelogram or room whose length is 14.0 and breadth 13.0.

The *length* of the parallelogram is its *base* and the *breadth* is its altitude.

Operation. $14.0 \times 13.0 = 182$; $182 \div 9 = 20\frac{2}{9}$ square yards.

How many square yards in a piece of oil-cloth 4.6 by 4.9? Performing the operation *duodecimally*, we find 4.6 × 4.9 = 21 square feet 4′.6.″
In this result the 4′ is $\frac{4}{12}$ of *a square foot*, and the 6″ is $\frac{6}{12}$ of $\frac{1}{12}$ of a square foot, or $\frac{6}{144}$ of a square foot; so that the 4.′6″ = $\frac{54}{144}$ of a *square foot* = 54 *square inches;* now dividing 21 square feet and 54 square inches by 9 = 2⅜ *square yards.*

OPERATION.

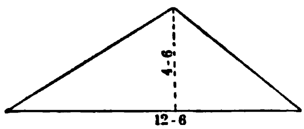
```
  4.6
  4.9
-----
16
  2.0
  3.0
   4 6
-----
21.4.6
```

Another method of performing the operation is to reduce the 6 and 9 *inches* to the denomination of feet,* and we find 4 feet 6 inches equals 4.50 feet, and 4 feet 9 inches equals 4.75 feet; then 4.50 multiplied by 4.75 gives 21.3750 square feet, and 21.3750 dividedby 9 gives 2.3750 *square yards;* reducing, equals 2⅜ square yards.

To find the area of a triangle from its base and altitude.

RULE. *Multiply the base by* HALF THE ALTITUDE; *or, half of the base by the altitude.*

Example. Find the area of a triangle, whose base is 12.6 and altitude 4.6.



Operation. ½ (4.6) = 2.3; 12.6 × 2.3 = 28.125 square feet, or 28 square feet 1′.6″, or 3⅛ square yards.

To illustrate this truth, take a piece of card-board and cut out two triangles *just alike*, as A and B, and place them together, as in Figure 2. A parallelogram is thus formed, whose base and altitude are the same as the base and altitude of the triangle. The area of this parallelogram is the product of its base and altitude.

---

* See page 52 for fractions and their equivalent decimals.

Hence, the area of one of the triangles is one-half the product of its base and altitude. It will also be observed that, by cutting the triangle B, Figure 2, into two triangles through the points *o o*, and placing the cut-off piece from the right-hand side of B to the left-hand side of A, at *s s*, a rectangle will be formed, having the same base and altitude as the triangles.

Fig. 1

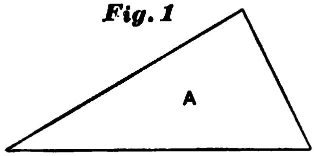
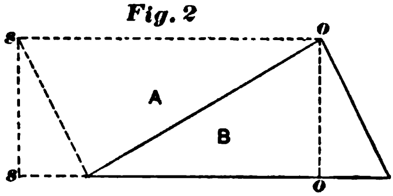


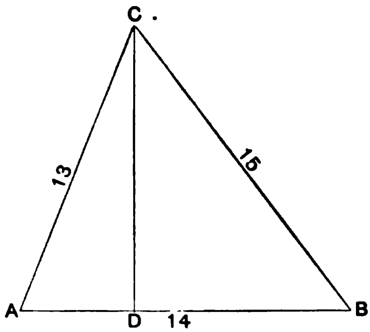
Fig. 2



To find the area of a triangle from its three sides.

RULE. *From half the sum of the three sides* SUBTRACT EACH SIDE; *multiply the half sum and the three* REMAINDERS *together, and extract the square root of the product.*

Example. Find the area of the triangle A C B, whose sides are 13, 14, and 15 feet, respectively. Then half the sum of the three sides is $\frac{1}{2}(13 + 14 + 15) = 21$; subtracting each side from this half sum, the three remainders are



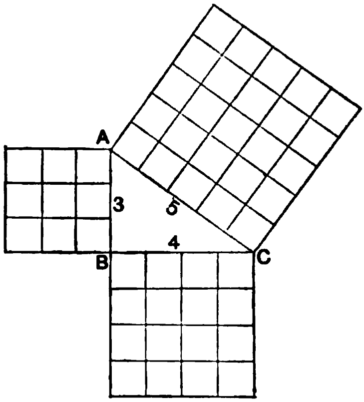
$$21 - 13 = 8.$$
$$21 - 14 = 7.$$
$$21 - 15 = 6.$$

Then, $21 \times 8 \times 7 \times 6 = 7056$. Extracting the square root of $\sqrt{7056} = 84$ square feet.

NOTE.—If a perpendicular is drawn from the vertex C to the base A B, then will this perpendicular, C D, measure 12 feet; then, 12 feet being the altitude of the triangle and 14 feet the base, performing the operation according to the rule on page 42, by multiplying the base by one-half the altitude, gives $\frac{1}{2}(12.0) = 6$; $14 \times 6 = 84$, which verifies the above.

APPLICATION OF THE SQUARE ROOT.

It is a known principle that the square on the longest side of a right-angled triangle is equivalent to the sum of the squares of the other two sides. To illustrate this proposition, let A B C be a right-angled triangle, right angled at B; let $AB = 3$, $BC = 4$, then will $AC = 5$; for the square on A B is $3 \times 3 = 9$, and B C is $4 \times 4 = 16$; the sum of these squares $9 + 16 = 25$, the square of the side A C.



Rule or formula for finding the hypotenuse when the base and perpendicular are known.

$$AC^2 = \sqrt{AB^2 + BC^2}.$$

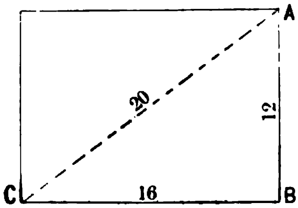
Formula for finding either side when the hypotenuse and one of the other sides are known.

$$AB^2 = \sqrt{AC^2 - BC^2}; \text{ or,}$$

$$BC^2 = \sqrt{AC^2 - AB^2}.$$

Application of the square root to the above proposition.

A rectangular room is 16 feet long, and the diagonal length is 20 feet; what is the width of the room? *Ans.* 12 feet.



Operation. Let the width of the room be represented by A B, the diagonal by A C, and the length by B C; then, according to Formula 2, page 44, $AB^2 = AC^2 - BC^2$. By substituting the above numbers, 16 and 20, and letting $AC = 20$, and $BC = 16$, then $AC^2 = 20 \times 20 = 400$, $BC^2 = 16 \times 16 = 256$; then, according to the conditions, $400 - 256 = 144$, or $AB^2 = 144$; $\sqrt{144} = 12$; then will the width of the room be 12 feet.

In a rectangular room, which is 12.6 wide by 14.3 long, what should be the length of the diagonal?

Operation. Let the diagonal be represented by A C, the width by A B, and the length by B C; then, according to Formula 1, $AC^2 = AB^2 + BC^2$. By substituting the above numbers, 12.6 and 14.3, and letting $AB = 12.6$, $BC = 14.3$ (reducing the 6 and 3 inches to the denomination of feet), then $AB^2 = 12.5 \times 12.5 = 156.25$; $BC^2 = 14.25 \times 14.25 = 203.0625$; then, according to the conditions $156.25 + 203.0625 = 359.3125$, or $AC^2 = 359.3125$; $\sqrt{359.3125} = 18.955 +$ or $18.11\frac{23}{50}$ nearly 18.11^2.

Can you mark out or describe a right-angled room that is 13 feet wide and 15 feet long, and whose diagonal is given as 21 feet? Try it; if not, why not?

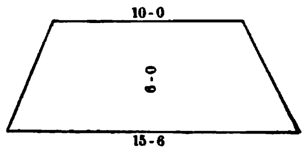
In Diagram 7, page 87, is the angle at A a right

angle? If not, is it less or greater than a right angle? If less or greater than a right angle, what is the proper definition of the angle?

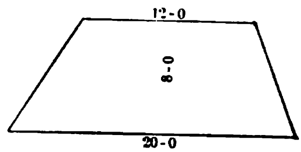
To find the area of a trapezoid.

RULE. *Multiply* HALF THE SUM *of the two parallel sides by the altitude of the trapezoid; that is, by the distance between the two parallel sides.*

Example. Find the area of a trapezoid whose parallel sides are 10.0 and 15.6, and altitude 6.0. Then $15.6 + 10.0 = 25.6 \div 2 = 12.9$; then $12.9 \times 6.0 = 76.6$, or $76\frac{1}{2}$ square feet, the area of the trapezoid.

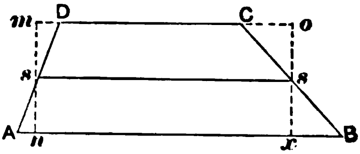


Or the area of a trapezoid can be found by multiplying the sum of the parallel sides by the perpendicular breadth, or altitude, and taking half the product. Then, $20 + 12 = 32$; $32 \times 8 = 256$; then $\frac{1}{2}$ of $256 = 128$ square feet, the area of the trapezoid.



Also the area of a trapezoid is the product of its altitude into the line joining the middle points of its inclined sides.

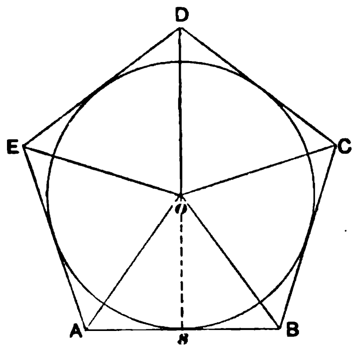
Thus, in the trapezoid A B C D, draw the straight line *s s* through the middle of the inclined sides, then draw the perpendiculars *m n* and *o x* through the points *s* and *s*. Now, it is evident if the triangle *s* A *n* is cut off from the figure, it will fit the space *s m* D;



likewise, $s\,x$ B will fit the triangle $s\,o$ C, thus forming the rectangle $n\,x\,o\,m$. Hence the area of a trapezoid is the product of its altitude, etc.

To find the area of a regular polygon.

RULE. *Multiply* HALF THE PERIMETER *by the* APOTHEM *or perpendicular drawn from the center of the polygon to one of its sides.*



Example. Find the area of a regular pentagon whose apothem is 8.6 feet and whose sides are each 12.5 feet.

Each side being 12.5 feet, and there being 5 sides, then $12.5 \times 5 = 62.5$; $62.5 \div 2 = 31.25$, half of the perimeter;* then, multiplying this number by the apothem, $31.25 \times 8.6 = 268.75$ square feet.

In the polygon draw o A and o B; then will o A B be a triangle, in which A B is the *base* and $o\,s$ the *altitude;* and by drawing the lines o E, o D, o C, o B, and o A to the vertices of the polygon, it will divide the polygon into as many triangles as it has sides; and regarding A B, B C, C D, D E, and E A as the bases of these triangles, and $o\,s$ the altitude, then will the area of the triangle A B $o = \frac{1}{2}$ A B $\times$ $o\,s$; by assigning the above lengths to this pentagon, let A B $= 12.5$ feet, and $o\,s$ 8.6 feet; then $\frac{1}{2}$ of $12.5 = 6.25$; $6.25 \times$

*The perimeter is the sum round about the polygon; an apothem is a radius of an inscribed circle in any polygon.

In this example the dimensions are given in tenths.

8.6 = 53.75 square feet, the area of the triangle A B *o*; and as the polygon has five triangles, then will the whole area equal $53.75 \times 5 = 268.75$ square feet.

Hence, the area of the several triangles, which is the area of the entire polygon, is equal to $\frac{1}{2}$ (A B + B C + C D + D E + E A) $\times$ *o s*.

The above can be applied to any *regular polygon* of any number of sides.

The area of a regular polygon can also be found by multiplying *the square of one of the sides* of the polygon by the area of a similar polygon whose side is unity.

Below is given a table for the construction and estimation of polygons:

NAME.		Angle at center. . . .	Angle at circumference,	Perpendicular side being 1.	Length of side radius being 1. . .	Radius of circle side being 1. . .	Radius of circle perpendicular being 1. . .	Area side being 1. . . .
Triangle, ...	3	120	60	0.2886	1.73	.579	2.	0.4330
Square, ...	4	90	90	0.5	1.412	.705	1.41	1.
Pentagon, ...	5	72	108	0.6882	1.174	.852	1.238	1.7204
Hexagon, ...	6	60	120	0.8660	1.	1.	1.156	2.5980
Heptagon, ...	7	$51\frac{4}{7}$	$128\frac{4}{7}$	1.0382	.867	1.16	1.11	3.6339
Octagon, ...	8	45	135	1.2071	.765	1.307	1.08	4.8284
Nonagon, ...	9	40	140	1.3737	.681	1.47	1.062	6.1818
Decagon, ...	10	36	144	1.5388	.616	1.625	1.05	7.6942
Undecagon, . . .	11	$32\frac{8}{11}$	$147\frac{8}{11}$	1.7028	.561	1.777	1.04	9.3656
Dodecagon, . . .	12	30	150	1.8660	.516	1.94	1.037	11.1961

APPLICATION OF THE TABLE.

The radius of a circle being $7\frac{1}{2}$ feet, require the side of the greatest octagon that may be inscribed therein:

$$.765 \times 7.5 = 5.7375, \text{ or } 5 \text{ feet } 8\tfrac{17}{20} \text{ inches.}$$

Each side of a heptagon is required to be 9 feet; require the radius of circumscribing circle:

$$1.16 \times 9 = 10.44, \text{ or } 10 \text{ feet } 5\tfrac{7}{25} \text{ inches.}$$

A perpendicular from the center to either side of a nonagon is required to be 14 feet; what should be the radius of circumscribing circle?

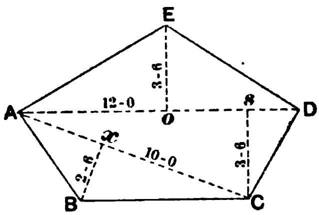
$$1.062 \times 14 = 14.868, \text{ or } 14 \text{ feet } 10\tfrac{52}{125} \text{ inches.}$$

Each side of a pentagon is 12 feet; require its superficial contents:

$$12^2 \text{ feet} = 144; \quad 144 \times 1.7204 = 247{,}7376 \text{ square feet.}$$

To find the area of an irregular polygon.

RULE. *Divide the polygon into triangles by diagonal lines, and measure as many lines as may be necessary for computing the area of the triangle.*



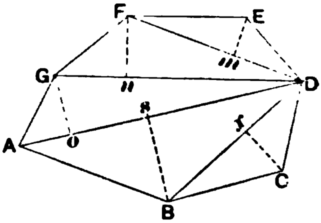
Thus, in the polygon A B C D E, divide the figure into three triangles, and let A D measure 12 feet, A C 10 feet, and the perpendiculars oE 3.6, sC 3.6, xB 2.6.

Then the area of the triangle	A B C is	$10.0 \times 1.3 =$	12.6
" " "	A C D "	$12.0 \times 1.9 =$	21.0
" " "	A D E "	$12.0 \times 1.9 =$	21.0
Therefore the area of the polygon is			54.6 sq. ft.

NOTE.—The area of any irregular room, hall, etc., of any number of sides, may be found by dividing it into as many triangles as will be required, being careful to give the lengths of the altitude or perpendiculars at right angles with the base.

In the polygon A B C D E F G, the area of the triangle F E D is computed by the base F D × ½ the perpendicular *m* E.

The triangle G F D, by the base G D × ½ the perpendicular *n* F.



The triangle A G D, by the base A D × ½ the perpendicular *o* G.

The triangle A B D by the base A D × ½ the perpendicular *s* B.

The triangle B C D, by the base B D × ½ the perpendicular *x* C.

NOTE.—It will be observed that the base A D is taken twice, for the reason that the perpendiculars *o* G and *s* B are drawn at right angles from the same base. Remember, always take the base from which the perpendiculars are drawn. If the triangle A B D were computed from B D × ½ *s* B, the area of the polygon would not be correctly given.

THE CIRCLE.

For practical purposes, the circumference of a circle is divided into 360 equal parts, called degrees; each degree is divided into 60 equal parts, called minutes; and each minute into 60 equal parts, called seconds.

To find the diameter when the circumference is given.

RULE. *Divide the circumference by 3.1416.*

Example. The circumference of a circle is 16 feet; what is the diameter?

$16 \div 3.1416 = 5.092 +$, or 5 feet $1\frac{13}{125}$ inches.

To find the circumference when the diameter is given.

RULE. *Multiply the diameter by 3.1416.*

Example. The diameter of a circle is 18 feet; what is the circumference?

$$18 \times 3.1416 = 56.5488, \text{ or } 56.6\tfrac{1}{2}, \text{ nearly.}$$

To find the area of a circle.

RULE 1. *Multiply the circumference by half the radius; or, by*

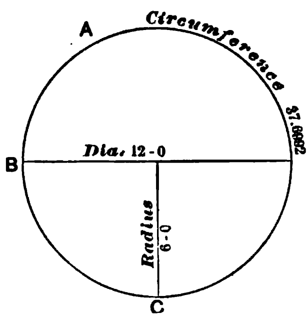
RULE 2. *Take ¼ of the product of the circumference and multiply the diameter; or, by*

RULE 3. *Multiply the square of the radius by 3.1416; or, by*

RULE 4. *Multiply the square of the diameter by 0.7854; or, by*

RULE 5. *Multiply the square of the circumference by .07958.*

Example. Let it be required to find the area of the circle A B C, whose diameter is 12 feet.



If the diameter is 12 feet, the circumference will be $12 \times 3.1416 = 37.6992$ feet, and the radius will be ½ of $12 = 6$ feet. Then, according to Rule 1, multiplying the circumference by half the radius, and performing the operation, $37.6992 \times 3 = 113.0976$ square feet; or,

By applying Rule 2; then, ¼ of $37.6992 = 9.4248$; $9.4248 \times 12 = 113.0976$ square feet.

By applying Rule 3; then, $6 \times 6 = 36$; $36 \times 3.1416 = 113.0976$ square feet.

By applying Rule 4; then, $12 \times 12 = 144$; $144 \times 0.7854 = 113.0976$ square feet.

By applying Rule 5; then, $37.6992 \times 37.6992 = 1421.22968064 \times .07958 = 113.1013 +$.

The ~~diameter~~ of a circle is 12.6; what is the area? *Ans.* 122.72 + square feet.

THE ELLIPSE.

To find the area of an ellipse.

RULE. *Multiply the product of the two axes by .7854, or the product of the semi-axes by 3.1416.*

Example. Find the area of an ellipse, whose major or transverse axis is 12 feet, and the minor or conjugate axis 9 feet.

Then, $12 \times 9 = 108$; $108 \times .7854 = 84.8232$ square feet.

FRACTIONS AND THEIR EQUIVALENT DECIMALS.

1 inch the integer or whole number.

.875	$\frac{7}{8}$	.5	$\frac{1}{2}$	.125	$\frac{1}{8}$
.75	$\frac{3}{4}$	.375	$\frac{3}{8}$	.0625	$\frac{1}{16}$
.625	$\frac{5}{8}$	.25	$\frac{1}{4}$	.03125	$\frac{1}{32}$

1 foot, or 12 inches, the integer.

.9166	11	.4166	5	.0625	$\frac{3}{4}$
.6338	10	.3333	4	.05208	$\frac{5}{8}$
.75	9	.25	3	.04166	$\frac{1}{2}$
.6666	8	.1666	2	.03125	$\frac{3}{8}$
.5833	7	.0833	1	.02083	$\frac{1}{4}$
.5	6	.07291	$\frac{7}{8}$	.01041	$\frac{1}{8}$

1 yard, or 36 inches, the integer.

.9722	35	.6387	23	.3055	11
.9444	34	.6111	22	.2778	10
.9167	33	.5833	21	.25	9
.8889	32	.5556	20	.2222	8
.8611	31	.5278	19	.1944	7
.8333	30	.5	18	.1667	6
.8056	29	.4722	17	.1389	5
.7778	28	.4444	16	.1111	4
.75	27	.4167	15	.0833	3
.7222	26	.3889	14	.0555	2
.6944	25	.3611	13	.0278	1
.6667	24	.3333	12		

PART II.

SUGGESTIONS FOR MEASURERS.

In making drawings for spaces to be measured, it is not absolutely necessary to draw the diagram to a scale, but get it as near in proportion as the eye can judge.

When there is a whole house, or a part of a house, to be measured, the drawing should be made as near proportion as possible, and locate all the rooms, halls, and the various doorways and the window recesses in their proper positions.

When parties are furnishing a part or a whole house, the measures are, in some instances, taken before any definite selections are made. Hence, by making a proportional plan of each floor, the customer can at once locate the different rooms and spaces for which he wishes to make selections. It will also assist the salesman very materially in assigning the different patterns and quality of goods that are selected for the different rooms and spaces; and the cutter also, as he can form a better idea as to how the borders should be arranged, and in what direction the seams or widths of the carpet should run. These are important questions to consider, and can be easily solved if the rooms, halls, and the various spaces are properly located and proportioned; but if each room

is measured separately, these questions will be solved more or less by guess-work.

All doors and window recesses should invariably be located. Should the doors and windows not cause any recess, they should, nevertheless, be marked or designated by the letters D and W, in their proper position,—for the reason that it is sometimes necessary to make "cross-joinings," and it is very objectionable to have them at the doors or windows; and should the doors not be located, nine times out of ten you will have the piecing at a door, where it should not occur.

The measurer should pay particular attention to instructions given him by the customer, and make a minute of them on his diagram; after which he should repeat the instructions to the party giving them, as this prevents any dispute that otherwise may arise.

As we have indicated, the measurer should carefully survey the rooms, halls, and spaces to be measured, noting all the jambs and recesses, as this will save a great deal of erasure.

The "front" of the house should invariably be at the bottom of the diagram, especially if there is a part or a whole house to be measured; * and make it a rule to place the figures at the sides and ends of the diagram in the same position, and not upside down, especially when there are several rooms

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* The "front" of the various drawings in this book are placed on the top of the page, except Diagrams 38, 39, 40, and 41, as they show to better advantage in that position in a publication of this character.

and halls on one drawing, as this will save the time and labor of turning the diagram from side to side. Besides, an irregular placing of the figures shows carelessness and want of system on the part of the measurer, who in the end accomplishes less work than the systematic draughtsman, whose neat and intelligent drawing can be readily understood by all at a glance, without further explanation.

Be particular, also, in designating the proper names of the various rooms and halls,—as, library, dining-room, second story, second room, bath-room, first floor, rear hall, etc.,—as the case requires. The measurer should also ascertain if parties have any preference as to the direction the seams or widths are to run, and how border is to be arranged, and note the facts on his diagram. When no instructions are given, the cutter is supposed to exercise his own judgment.

If a customer should request from the measurer a statement of the number of yards that his room requires, he should inform him that the estimate is only approximate, he not knowing what loss there will be in matching the figures.

HINTS ON MEASURING.

Diagram 1 is a plain room, with no other offsets than the fire-place, and all angles are supposed to be right-angled.

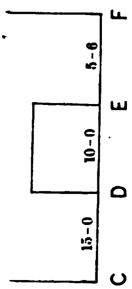
After making the drawing and locating the doors and windows (which should invariably be done), get the distance from A to B, by laying the tape-line close along the skirting or base-board; then from A to F; next, B to C; then the length of each recess and fire-place, as C to D, D to E, E to F; then the distance, 13.6, from fire-place to the wall line, A B; also, the depth of fire-place, which completes the diagram.* If the small projections on each side of the fire-place are only two or three inches, they may be omitted. In giving the length of recess, measure from each end of the room to the hearth-stone; but if the length is given from each end to the projections, then give the size of the latter; otherwise the sum of all the lengths on this side of the room will not verify the total length.

The next step is to verify the diagram; that is, to ascertain if the sum or product of the different lengths from C to F will equal the given length 15.0 from

* The method for ascertaining if the room is square is as follows: From A towards B mark off three feet; from A towards F mark off four feet, making in each case a point on the floor against the base-board. The distance between these two points will measure exactly five feet, if the room is square. It is preferable, however, to give the diagonal lengths, as shown in the various diagrams, as there will be less liability to err, and it is more accurate and expeditious than the above method. The diagonal lengths will establish the correct position of the room, no matter how irregular it may be.

A to B; also, the given distance, 13.6, from wall to fire-place; and the depth of the latter should equal the given distance, 15.6, from A to F. Thus, $5.6 + 4.6 + 5.0 = 15.0$, the distance from A to B; again, $13.6 + 2.0 = 15.6$, the distance from A to F,—which proves that the diagram is correct.* This is undoubtedly the best method for taking measures, as any error that may be made can easily be detected.

Some carpet-measurers take running or extension



measurements; that is, they stretch their line across the fire-place side of the room, and mark off the lengths thus: From F to E 5.6, F to D 10.0, F to C 15.0. Now, there is no opportunity to verify the correctness of these measurements. Another disadvantage is: Suppose it is required to find the length of fire-place, or the length of each recess, you will be obliged to make the necessary deductions to obtain the required length; whereas, by taking each length separately, you can tell at a glance what are the different lengths, without any further calculations.

An error that is frequently made by beginners is, in giving the length of stair-case, Diagram 22, from B to C, they measure from the front end of newel post at *o* to the point *x*; now, what will be the result? By adding the three different lengths from A to B, *o* to *x*, C to D, the product will not equal or

* The advantage according to this manner of measuring is to detect errors that are caused by transposing numbers; for instance, by giving the length from F to E 6.5 instead 5 6, when there will be a difference between the sum of the shorter lengths and the total length of 11 inches.

verify the total length. Why? Because the length of the stair-case was given too long plus the projection from *r* to *s*. In order to get the length from B to C, mark off from the point *o* towards *x* the length *r s;* from this point to the point *x* will be the length of B C.

Diagram 2 is an ordinary room, with fire-place and closet. Give all the measurements as indicated by those given in this diagram.

Diagram 3 is a plan of a front parlor, with sliding doors, fire-place, and window recesses. Get all the measurements as indicated by those in diagram. In taking the separate measurements, care should be used in marking the exact point to which the length has been carried, before removing the tape-line; otherwise the product of the shorter lengths will not verify the total length.

As will be observed, there is a difference of 1½ inches between the front and rear ends of this room; it is therefore advisable, in all cases, to measure the front and rear ends, and also the two sides of a room.* The total lengths should be given, as from A to B, B to C, and A to D, in addition to the shorter lengths, as it frequently occurs that the sum of the shorter lengths will not prove the total lengths, being sometimes a fractional part of an inch too long or short, owing to imperfection in the tape-line,† or want of accuracy

*It is very seldom that a room will measure the same at front and rear, and a like variation may exist at the sides; it is therefore advisable, especially for bordered carpets, to give the diagonal lengths, as these will establish the correct position of the room.

†In measuring, use a Chesterman's metallic tape-line in place of a two or three foot rule, as the lengths can be more accurately determined with the former than the latter.

in marking the points before removing the tape-line. For this reason, the total lengths are desirable, and should be given in all cases, as also the total length across the fire-place, by placing the tape-line as close along the chimney-breast as possible.

Diagram 4 is a room generally termed, by the carpet trade, a crooked room; but, properly speaking, the room is not right-angled, only one of its angles being right-angled at D.

In measuring the lengths 15.6, 17.2, and 16.0, care should be taken to have the tape-line parallel with the line of the walls. It is sometimes necessary, in a room whose angles are not right-angled, to give the length of recess from corner to corner, and the size of the small projections on each side of fire-place, in order to get the extreme length from D to C. The room can be constructed without the length from D to C, by giving the two diagonals; but to insure greater accuracy, the length from C to D should also be given.

Diagram 5 is another "crooked room."* Geometrically speaking, it is a rhomboid, neither of its angles being right-angled, but having two obtuse and two acute angles. We would again impress upon the measurer to be very accurate in giving the measurements to a fractional part of an inch. By doing so, there will be no difficulty in describing or reproducing the diagram, if all the lengths are given as shown

* If a room, hall, or any space is not right-angled, do not say that it is crooked, or that it is not straight, or that it is uneven, or "jumbled up," or such like expression; simply say, it is not right-angled.

in this figure. The diagonal lengths will establish the correct position of all the angles.

Diagram 6. In this room all the angles are unequal, and only one diagonal length is given. This room can be described accurately according to the measurement here given, but can not be verified. Thus, supposing an error should be made in putting down thirteen feet instead of fourteen feet,—then, only one diagonal length being given, there is no opportunity of detecting the error; for, after marking out the angle D A B, the angle B C D can only be constructed according to the lengths from B to C and D to C; but by giving the two diagonals, D B and A C, the diagram can be verified as to the correctness of the figures. Therefore, it is advisable to give the two diagonals in all cases, if they can be obtained.

Diagram 7 is an irregular room. Geometrically speaking, it is an irregular polygon. Its angles are neither equilateral nor equiangular; that is, all its sides are unequal, and all its angles are unequal. The measurements here given will locate the various angles. It will be observed that all the diagonals are given from one point, B. The room can be reproduced from the measurements here given, but can not be verified unless the diagonal from A to C is given. The measurer should thoroughly understand the value of each diagonal length, and not give them indiscriminately, because upon these depends the construction of the room. As will be observed by the given measurements, the room is divided into four triangles;

thus, A B F, F B E, E B D, and D B C. Then, as shown in Problem 8, the room can be easily constructed, for the reason that it is divided into a series of triangles according to the given measurements; and upon the triangle depends the accuracy of reproducing the room correctly.

Diagram 8 is a room with the fire-place in one of its angles. The measurements here given are sufficient to establish the position of the fire-place; but if the points D and C are not clearly defined, they being obstructed by moldings, give the additional measurements as suggested on page 88.

Diagrams 9 and 10 are octagonal rooms. The measurements here given will show the different lengths that are required. In many cases only the outside measurements are given, and no total length or width is stated. This may answer for rooms that have all the angles equal, as in Diagram 9, which can be reproduced by only giving the outside measurements; but how many rooms have all the angles equal? True, the architect has all the angles equal on his plan; but, in building, the builder or carpenter, through faulty construction or otherwise, gets the angles unequal to a greater or less degree, as in Diagram 10. In such an event it will be exceedingly difficult to reproduce this room accurately if only the outside measurements are given, even with the additional total length and width; but by giving the two diagonals and all the other dimensions, as indicated in Diagrams 9 and 10, the rooms can be readily constructed.

Some measurers have a habit of sighting the distance from the points H and A at right angles as H *s* and A *s*, Diagram 9. This should be avoided, as it is nothing more than guess-work. These lengths are really unnecessary; for the room can be easily and correctly constructed according to the measurements here given.

Diagram 11 is a plan of double parlors, with sliding doors separating the two rooms. All the measurements should be given as shown in this diagram. The sills at door entrances have, in most cases, within the last few years, been abolished. This causes a small recess at each door entrance of about three inches, as in this and Diagram 3. These should be invariably located, for the reason that, if the room should have a border carpet, a small piece of plain filling or carpet can be sewed to the outside of border; and if the room is without a border, it is better to sew on an extra strip rather than cut and turn under three inches of the first width. Should this recess be ignored, it will show the hall or adjoining room carpet, as the case may be, in the parlor, when the door is closed; and if the parlor and hall are laid in different patterns, it will not look well. For this reason, an extra piece of the parlor carpet should be put in the doorway, and joined under the door; but should the adjoining rooms or halls be covered with the same pattern, or if solid color filling is used, then, of course, the doorway should be in one piece for the full depth of wall. When there are no sills between adjoining

rooms or halls, as in Figure 22, draw the straight line indicating the door, as is shown in this and Diagram 3; and if a sill, draw the straight line as shown in Diagrams 1, 2, 4, 5, etc.

In many instances, in houses of recent construction, the sliding doors hang or slide from the top, thus avoiding all obstructions between the connecting rooms.

The measurer should make a note on his plans, whether the door slides from the top, or at the bottom on rail. Diagram 11 shows that the double-door slides from the top; but if at bottom on rail, draw a straight line across the opening between the jambs.

Diagram 12 is a front parlor, with a circle bay-window. Give all the different lengths as indicated in this figure. Many measurers, in measuring a circular window, will draw a straight line across the opening of the window from D to E, and then divide this line into an equal number of parts, at a distance from six to twelve inches; then, from these points, and at right angles with the straight line, they will get the different lengths to the circumference of the window. Now, this method requires great accuracy and considerable time; whereas, according to the method suggested in this diagram, the measurements can be taken as correctly, and much more expeditiously than by the ordinary mode. It will be observed that only three lengths are required from D to E, D to S, and E to S. The point S can be located at any convenient point in the circumference by marking a dot or line on the

skirtings of the base-board; and then, from the points D and E, get the length to this point S. The measurer, in order to satisfy himself that the circle is a part of a true segment of a circle, should bisect the lines D S and E S, as shown in Problem 1, and where these lines intersect each other, as shown in Problem 12, will be the center or radius of the circle. From this point he can easily determine how much, if any, the circle is from being true.

Very frequently it occurs that the circle is not as true as you would describe one on paper or on the floor, as there is more or less variation in the course of its construction; but, for all practical purposes, the measurements here given and suggested will be found to be accurate. The writer has, in most instances, treated circles according to the above method with satisfactory results, except where there has been too great a variation through faulty construction, in which case it will be necessary to measure the window as described in Diagrams 34 and 35.

Problems 10, 11, and 12 can only be used for circles or parts of circles which have been described from one common center, and can not be applied to ovals and ellipses.

Diagrams 13, 14, 15, etc., are variously shaped rooms. The measurements given in each room will afford a general idea how to proceed. If any one should think that some of the measurements given are superfluous, he will find, after familarizing himself with the various plans, that they are all absolutely essential

in establishing and verifying the correct position of rooms. This will be demonstrated in the next chapter, to which the reader is referred.

NOTE.—The measurements in the various diagrams have been taken with a steel tape-line (twelve inches to one foot). The dimensions given have been taken with great care, and are as nearly accurate as can be obtained. They probably will not bear the rigid test of numerical deduction; for it is an impossibility to produce and measure a line with such precision as we can by abstraction. Thus, in a square 15.0 by 15.0, its diagonal length to four points of a decimal is 21.2132 + feet, or 21 feet $2\frac{349}{625}$ inches, which, by tape-line measurement, would only register $21.2\frac{1}{2}$, which is sufficiently accurate for all practical purposes.

GENERAL DEMONSTRATION,

SHOWING HOW TO REPRODUCE THE VARIOUS DIAGRAMS ON THE FLOOR ACCURATELY AND SCIENTIFICALLY.

DIAGRAM A, FIGURE 1.

Let it be required to reproduce or to "mark out" Diagram A, Figure 1, on the floor.

EXPLANATION IN DETAIL.

1. Draw the straight line A B indefinitely, and upon it lay off the length, 16.6; let A B represent this distance.

Illustration. By this it is understood that I * take the chalk-line and fasten the end to the floor.† When I think that I have a sufficient length, I draw it firm; then, raising it slightly, I let it snap, thus producing a straight line. On this chalk-line I measure off the distance, 16.6. For our illustration, let us mark this length by the points A and B.

2. From the point A as a center, with a radius of 15.0, describe an arc at D.

Illustration. I take the tape-line, and fasten the end by sticking an awl through the brass ring, in the point A; then, walking towards D, with a distance or length of 15.0, I draw the tape-line taut, and, allowing it to move freely, I describe a part of a circle, or, more properly speaking, an arc of a circle, as m m.

3. From the point B as a center, with a radius of 22.10$\frac{3}{8}$, describe an arc, cutting the former arc in D; through this intersection draw D A.

---

* This demonstration is put in the singular, as it is simpler, and will be more readily understood.

† Of course it is understood, if you have some person to hold the chalk-line and tape-line, instead of fastening and removing them at the various points, the room can be much more expeditiously described.

Illustration. I now fasten the tape-line in the point B. and, walking in a diagonal direction towards D, with a length of 22.10⅜, I describe another arc of a circle, as **o o**, so as to cut or cross the circle **m m** that was described from the point A. Now I take the chalk-line, and, fastening it in the point A and walking towards D, I draw the chalk-line *directly over the point* where the two circles **o o** and **m m** cross each other, and, drawing the chalk-line firm, I snap it, thus producing a straight line from A to D.

4. From the point B as a center, with a radius of 14.4⅛, describe an arc at C.

Illustration. Again fastening the tape-line in the point B, and walking towards C with a length of 14.4⅛, I describe another arc of a circle, as **x x**.

5. From the point A as a center, with a radius of 20.10⅜, describe an arc cutting the former arc in C; through this intersection draw C B.

Illustration. I now fasten the tape-line in the point A, and, walking in a diagonal direction towards C, with a length of 20.10⅜, I describe another arc of a circle, as **n n**, so as to cut or cross the circle **x x**, that was described from the point B. I now take the chalk-line, and fasten it at the point B, and, walking towards C, I draw the chalk-line *directly over the point* where the two circles **n n** and **x x** cross each other, and, drawing it firm, I snap it, thus producing the straight line B C. Now I fasten the chalk-line in the point C; that is, where the two circles **n n** and **x x** cross each other; then, walking towards D, I draw the chalk-line *directly over the point* where the circles **m m** and **o o** cross each other, and, drawing the chalk-line firm, I snap it, thus producing the straight line C D, which will measure 16.0. This completes the diagram.

In describing the arcs of circles **m m**, **o o**, **n n**, and **x x** with the tape-line in the above manner, we proceed on the same principle as in describing a circle or part of a circle with a compass; that is, by placing one

DIAGRAM A.

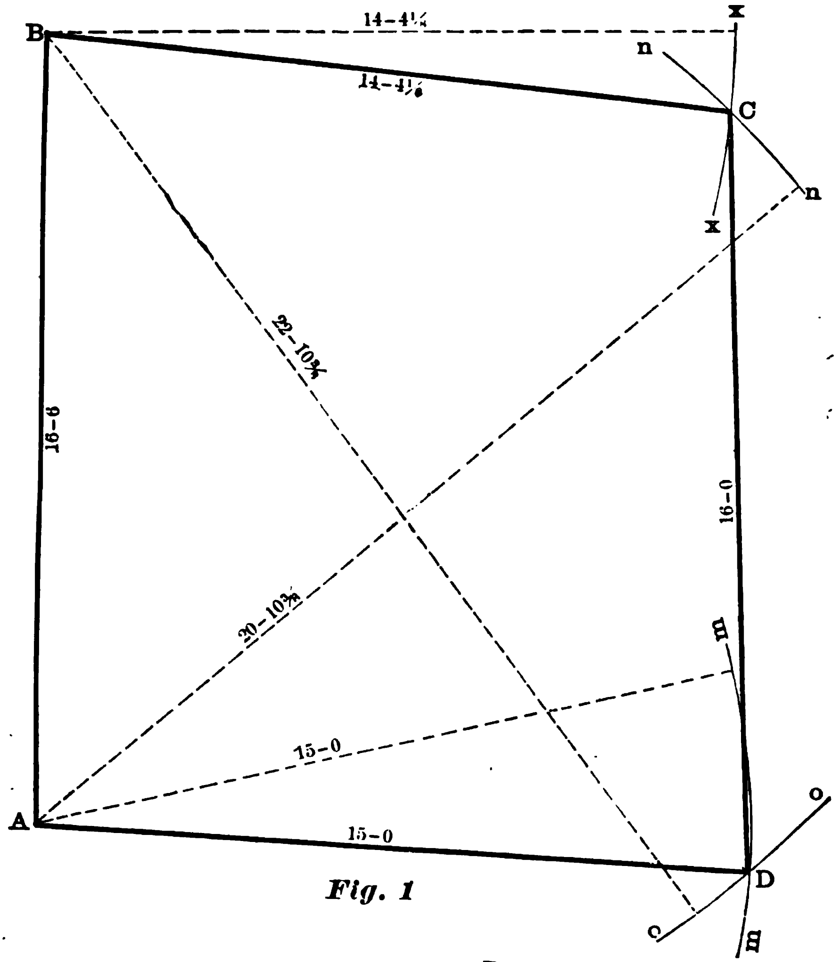


Fig. 1

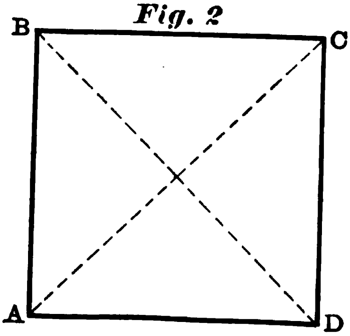


Fig. 2

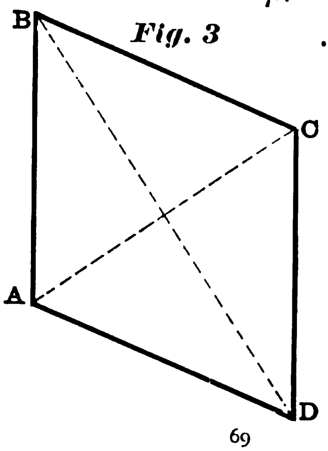


Fig. 3

foot of the dividers in the point A, and with the other describing the arc **m m**. The distance between these various arcs of a circle is called the *radius*, because they are generated from one common point called a *center;* and the point where they cut each other is termed the point of *intersection.** Observe carefully that the distance from the point A to any point in the arc **m m** is just the same. Why? Because this arc is part of a circumference of a circle, the point A being the center, and the length, 15.0, is the radius describing the circumference, or the arc **m m**. This same reasoning is applied to the arcs **o o**, **x x**, and **n n**.

Care should be taken in drawing the chalk-line through points of intersections; and in describing arcs of circles, use a hard chalk pencil, well pointed, so as to define the points of intersection distinctly and accurately. The beginner, and those with limited experience, should reproduce the diagram according to the above method, and, after becoming thoroughly familiar with the process, they will be able to do it more quickly, as in the following suggestion:

Suggestion. 1. Draw an indefinite chalk-line. Fasten the tape-line in a point of the chalk-line, as at A; cut the chalk-line in the point B; describe the arcs **m m** and **n n**. Remove the tape-line from A, and fasten it in the point B; then describe the arcs **x x** and **o o**. Now remove the tape-line from B, and measure the length C D, to verify the diagram. It will be observed that the tape-line has only been removed three times.

---

* Intersection means to cross. A radius is a line drawn from a center to any point in the circumference of a circle.

In this Diagram A, Figure 1, none of the angles are right-angled. It is evident that, according to the above manner of reproducing the room, it does not matter how unequal the angles may be—or, as it is sometimes expressed, how crooked the room may be—providing the diagonal measurements are given, as they divide the room into triangles; and, as shown in Problem 8, a triangle can be constructed accurately if the three sides are given.

The triangles by which the above figure has been constructed are B A D and A B C. Now, supposing only one diagonal to be given, as A C; then the triangles by which the room is constructed is A B C and A D C; and it can be reproduced as accurately as if the additional diagonal from B to D had been given. Then the question arises, why give two diagonal lengths if one will suffice? Supposing an error to be made in measuring a room of unequal angles like the above—as in putting down 16.0 instead of 15.0 from A to D, or any of the other lengths—the result would be that the room would be described according to the given measurements, with no apparent indication of the error, as may be seen by studying the diagram. It is therefore advisable and prudent to give both diagonal lengths, as well as the two sides and ends, to verify the diagram.

To illustrate more plainly the important feature and the necessity of the diagonal lengths,—suppose we take a pasteboard box, with the bottom cut out and the sides left joined together. Let Figure 2

represent the outline of this box. It is evident that the diagonals from A to C and B to D will measure *just alike*. Now, suppose we press together the opposite sides, A C, producing the shape as in Figure 3; and what is the result as to the *size* of the figure? It is certain that neither the ends nor sides of the figure have been increased or diminished, because the card-board figure is still joined together at each of its corners as it was in Figure 2; but, as will be observed, the distance from B to D has been increased, and from A to C has been diminished. It is thus evident that, in order to reproduce the position of Figure 3, it will be necessary to give the distance from A to C or B to D.

Query. How has the *area* of Figure 3 been affected? Has it been increased, diminished, or does it remain the same?

For those who are not familiar with the above manner of construction, this is a good time to master it. After the *modus operandi* is once thoroughly understood, there will be no difficulty in reproducing irregular rooms and spaces, as by this method all rooms can be accurately constructed.

DIAGRAM 1.

Let it be required to reproduce, or to mark out, Diagram 1, all the angles supposed to be right-angled.*

1. Draw an indefinite chalk-line, and upon it lay off the distance 15.0 from A to B.

2. Construct a right angle at A (as in Problem 3), thus: On the straight line already produced measure off 9.0 from A to **o**.

3. From the point A as a center, with a radius of 12.0, describe an arc at **x**.

4. From the point **o** as a center, with a radius of 15.0, describe an arc cutting the former in **x**; through this intersection draw a straight line long enough for the width of room.

5. On this straight line measure off the given distance 15.6 from A to F.

6. From the point B as a center, with a radius equal to the given distance 15.6, describe an arc at C.

7. From the point F as a center, with a radius equal to the given distance of 15.0, describe an arc cutting the former in C; through this intersection draw the straight lines C B and C F,—which completes the square.

8. From F measure off 5.6 to E; E to D 4.6; D to C 5.0; then from the points D and E as centers, with a radius equal to the given distance 2.0, describe arcs at **s** and **s**.

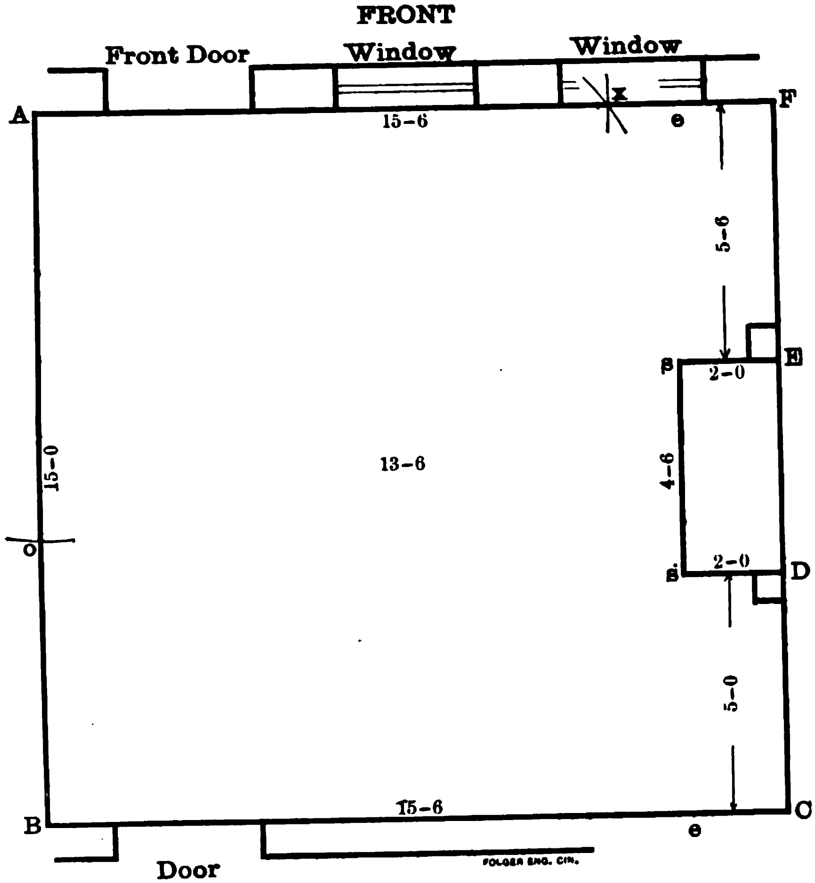
---

*The reader is now supposed to be familiar with the terms and signification of radius, arc, point, center, and intersection.

9. On the straight lines F A and C B, and from the points F and C, measure off 2.0, as at **e e**.

10. From the points **e e**, with a radius of 5.0 and 5.6, describe arcs cutting the former in **s** and **s**; then draw the straight line D **s**, E **s**, and **s s**; and the distance from the fire-place to the opposite side will measure 13.6,—which completes the diagram as required.

NOTE.—It will be observed that the word "arc" is not repeated after the word "former," as it is in section 3, page 67, referring to arc in preceding section, as it is supposed the word "arc" in each subsequent section will be understood.



FRONT
Front Door
Window
Window
A
F
15–6
e
x
5–6
s
E
2–0
13–6
15–0
4–6
o
2–0
s.
D
5–0
B
15–6
C
e
Door
FOLGER ENG. CIN.

DIAGRAM 1.

DIAGRAM 2.

Let it be required to reproduce Diagram 2.

1. Draw the straight line A B indefinitely, and upon it lay off the given length 15.6.

2. From the point A as a center, with a radius equal to the given distance 14.3, describe an arc at F.

3. From the point B as a center, with a radius equal to the given diagonal $21.0\frac{3}{4}$, describe an arc cutting the former in F; through this intersection draw the straight line F A.

4. From the point B as a center, with a radius equal to the given distance 13.0, describe an arc at C.

5. From the point A as a center, with a radius equal to the given diagonal $20.2\frac{1}{8}$, describe an arc cutting the former in C; through this intersection draw the straight line C B.

6. From C draw C D parallel to A B (as in Problem 6), equal to the given distance 5.9.

7. From D draw D **s** parallel to C B, equal to the given distance 1.0.

8. Draw **s s** parallel to A B, and equal to the given distance 5.0.

9. From **s**, draw **s** E parallel to A F, and equal to the given distance 2.3; then, from the points E and F draw the straight line E F, which will be parallel with A B, and this distance will measure 4.9,—which completes the diagram as required.

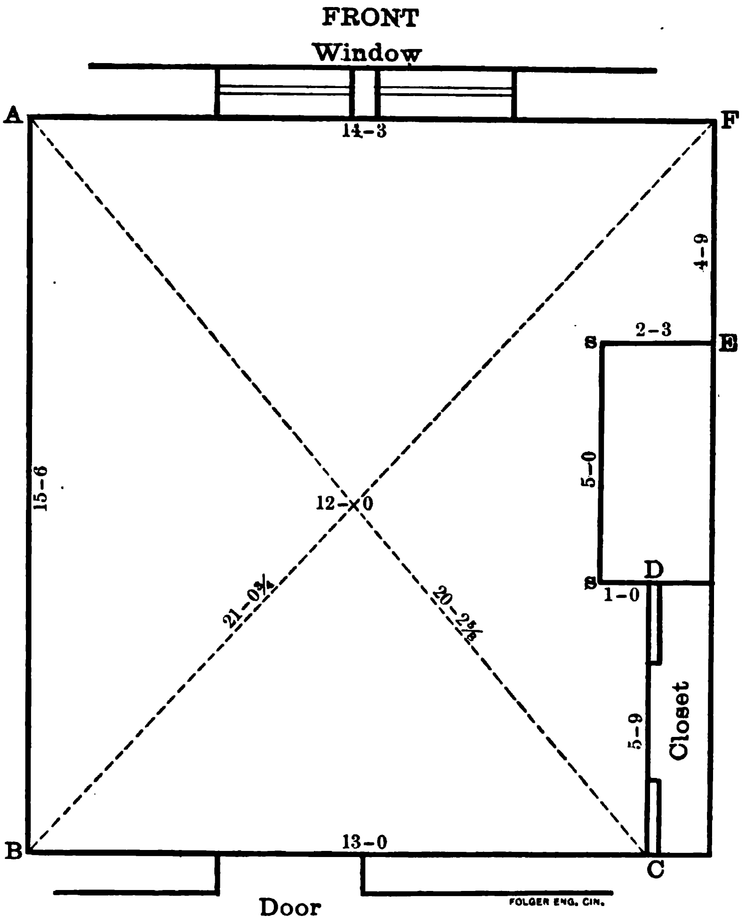

FRONT
Window
A
F
14-3
4-9
S
2-3
E
5-0
15-6
12-0
D
S
1-0
21-0¾
5-9
Closet
B
13-0
C
Door
FOLGER ENG. CIN.

DIAGRAM 2.

DIAGRAM 3.

Let it be required to reproduce Diagram 3.

1. Draw the straight line A B continuously, and equal to the given distance 16.6.

2. From A,* with a radius of 15.0, describe an arc at D.

3. From B, with a radius of 22.4, describe an arc cutting the former in D; through this intersection draw D A continuously.

4. From B, with a radius of 15.1½, describe an arc at C.

5. From A, with a radius of 22.4½, describe an arc cutting the former in C; through this intersection draw C B continuously.

6. Through the points D and C draw the straight line D C; and on this straight line locate the position of fire-place according to the given distances in the points **o o**.

7. On the straight line B C locate the position of the sliding door, thus: From B mark off 4.0 to **s**, **s** to **s** 7.0, **s** to C 4.1½; from the points **s** and **s** erect perpendiculars to **x x** equal to the given distance 1.1; join **x x**; and in the same manner locate the two windows and side door recess,—which completes the diagram as required.

---

* We will now be brief in our description, and will omit the expression "From the point A as a center, with a radius equal to the given distance 15.0, describe an arc at D," etc., and instead simply say, "From A, with a radius of 15.0, describe an arc at D;" this having the same meaning as the former.

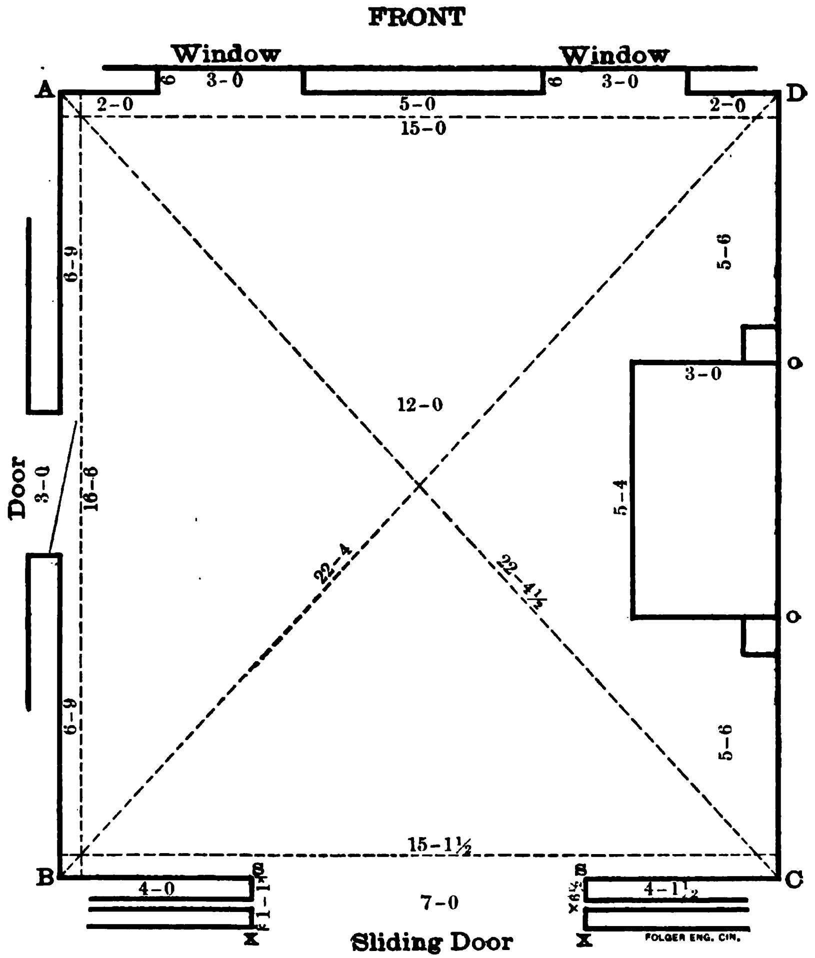

FRONT
Window
Window
A
D
B
C
3-0
3-0
2-0
5-0
2-0
15-0
6
6
6-9
16-8
Door
3-0
6-9
12-0
22-4
22-4½
5-6
3-0
5-4
5-6
O
O
15-1½
4-0
7-0
4-1½
S
S
X
X
Sliding Door
FOLGER ENG. CIN.

DIAGRAM 3.

DIAGRAM 4.

Let it be required to reproduce Diagram 4.

1. Draw the straight line A B equal to the given distance of 17.2.

2. From A, with a radius of 15.6, describe an arc at D.

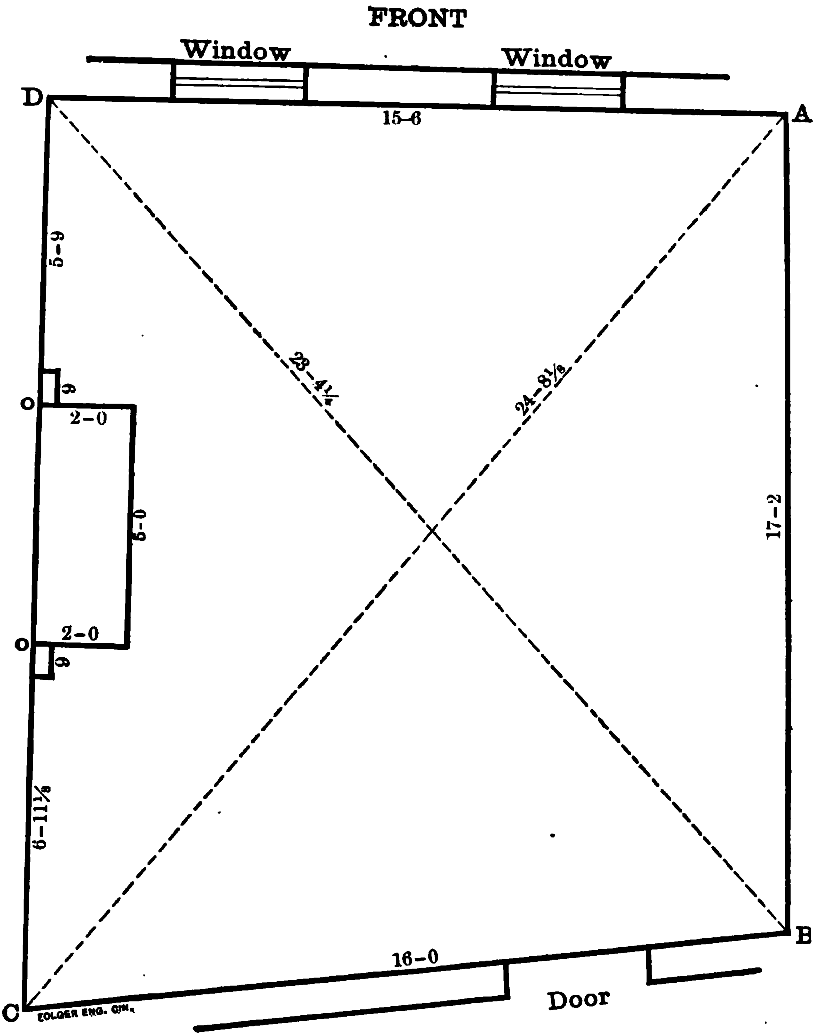
3. From B, with a radius of 23.4¼, describe an arc cutting the former in D; through this intersection draw D A.

4. From B, with a radius of 16.0, describe an arc at C.

5. From A, with a radius of 24.8½, describe an arc cutting the former in C; through this intersection draw C B.

6. Join the points D C by a straight line, and on this line locate the position of the fire-place equal to the given distances in the points o and o, and at right angle with C D,—which completes the diagram as required.

NOTE.—It will be observed that the angle at D is the only right-angled corner in the room. It will be well again to impress upon the beginner and those with limited experience, that all measurements should be taken parallel with the line of the base-boards, especially if the room is out of square; otherwise it is impossible to construct the diagram accurately. Some measurers have different ways of measuring rooms of an irregular shape. By using a square, or by sighting, they determine how much the angle varies from a right angle. This method not only requires longer time, but is done more or less by conjecture; whereas, according to the above manner of measuring and reproducing the room, the principle is absolutely correct.



FRONT
Window
Window
D
A
15-6
5-9
9
2-0
6-0
2-0
9
23-4¼
24-8⅛
17-2
6-11⅛
16-0
B
C
Door
FOLGER ENG. CIN.

DIAGRAM 4.

DIAGRAM 5.

Let it be required to reproduce Diagram 5.

1. Draw the straight line A B equal to the given distance of 15.6.

2. From A, with a radius of 13.7, describe an arc at D.

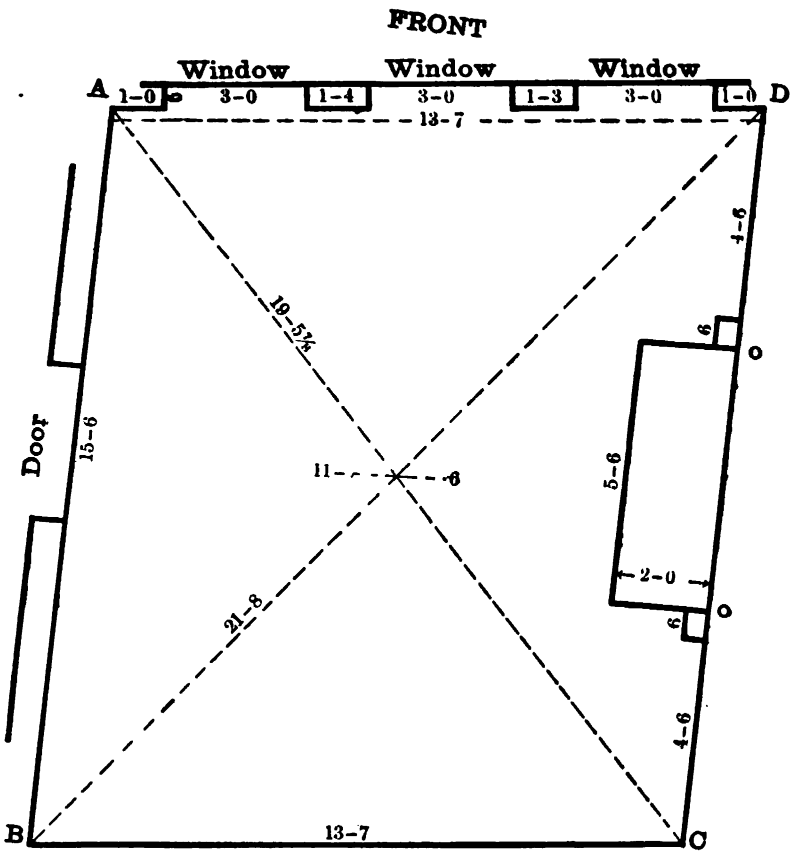
3. From B, with a radius of 21.8, describe an arc cutting the former in D; through this intersection draw D A continuously.

4. From B, with a radius of 13.7, describe an arc at C.

5. From A, with a radius of 19.5$\frac{7}{8}$, describe an arc cutting the former in C; through this intersection draw C B.

6. Join the straight line C D in the points of intersection at C and D, and on this straight line locate the position of the fire-place at right angles in the points o and o, as shown in the preceding diagrams.

7. On the straight line A D locate the position of the three windows, as described in Diagram 3,—which completes the diagram as required.



FRONT
Window
Window
Window
A
D
B
C
1-0
3-0
1-4
3-0
1-3
3-0
1-0
13-7
4-6
19-5⅞
6
o
Door
15-6
11
6
5-6
2-0
o
6
21-8
4-6
13-7

DIAGRAM 5.

DIAGRAM 6.

Let it be required to reproduce Diagram 6.

1. Draw the straight line A B equal to the given distance of 16.0.

2. From A, with a radius of 13.0, describe an arc at D.

3. From B, with a radius of 19.0¾, describe an arc cutting the former in D; through this intersection draw D A.

4. From D, with a radius of 14.0, describe an arc at C.

5. From B, with a radius of 12.0, describe an arc cutting the former in C; through this intersection draw C B and C D,—which completes the diagram as required.

NOTE.—Should there be an error made in one of the given lengths, there will be no means of detecting it; therefore it is advisable to give both diagonals.

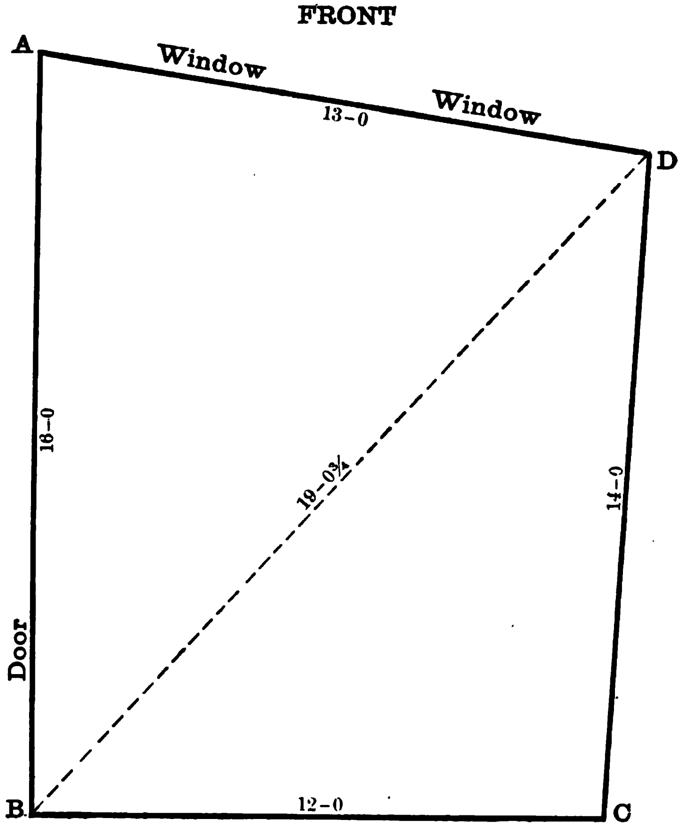


DIAGRAM 6.

DIAGRAM 7.

Let it be required to reproduce Diagram 7.

1. Draw the straight line A B equal to the given distance of 16.0 feet.

2. From A, with a radius of 10.0, describe an arc at F.

3. From B, with a radius of 19.3$\frac{5}{8}$, describe an arc cutting the former in F; through this intersection draw the straight line F A.

4. From F, with a radius of 4.6, describe an arc at E.

5. From B, with a radius of 19.5$\frac{1}{8}$, describe an arc cutting the former in E; through this intersection draw the straight line E F.

6. From E, with a radius of 5.6, describe an arc at D.

7. From B, with a radius of 16.7$\frac{5}{8}$, describe an arc cutting the former in D; through this intersection draw the straight line D E.

8. From D, with a radius of 13.0, describe an arc at C.

9. From B, with a radius of 4.11$\frac{7}{8}$, describe an arc cutting the former in C; through this intersection draw the straight lines C D and C B,—which completes the diagram as required.

NOTE.—In order to verify this diagram, the diagonal from A to C should be given.

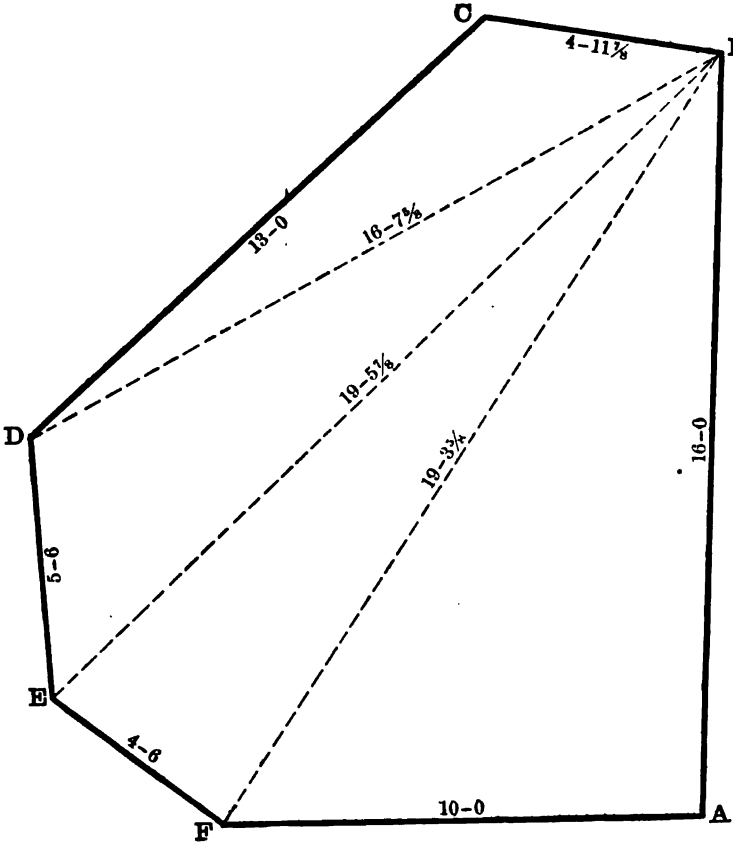
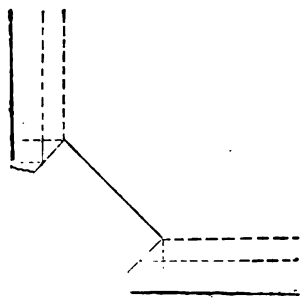


DIAGRAM 7.

DIAGRAM 8.

Let it be required to reproduce Diagram 8.

1. Draw the straight line A B equal to the given distance 15.0.



2. From A, with a radius of 15.0, describe an arc at E.

3. From B, with a radius of 21.2½, describe an arc cutting the former in E; through this intersection draw the straight line E A.

4. From B, with a radius of 11.6, describe an arc at C.

5. On the straight line A E, and from the point A, measure off 11.6 towards E, which is the distance from B to C; then from this point, with a radius of 15.0, describe an arc cutting the former in C; through this intersection draw the straight line C B.

6. From E, with a radius of 11.6, describe an arc at D.

7. On the straight line A B, and from the point A, measure off 11.6 towards B, which is the distance from E to D; then from this point, with a radius of 15.0, describe an arc cutting the former in D; through this intersection draw the straight line D E; join the points C D, and it will be found to measure 4.11½.

8. From the points C and D, with a radius of 2.0, describe arcs in o and o.

9. Draw 1.5 parallel with the straight lines B C

and E D, cutting the arcs in o and o; through these intersections draw o o, also join C o and D o,—which completes the diagram as required.

NOTE.—Should the points C and D be inaccessible, they being obstructed by moldings as shown in the marginal figure, page 88, get the different lengths as shown by the dotted lines, locate these points according to the method as described above, and join the straight lines through these points, which will establish the position of the fire-place true enough for all practical purposes..

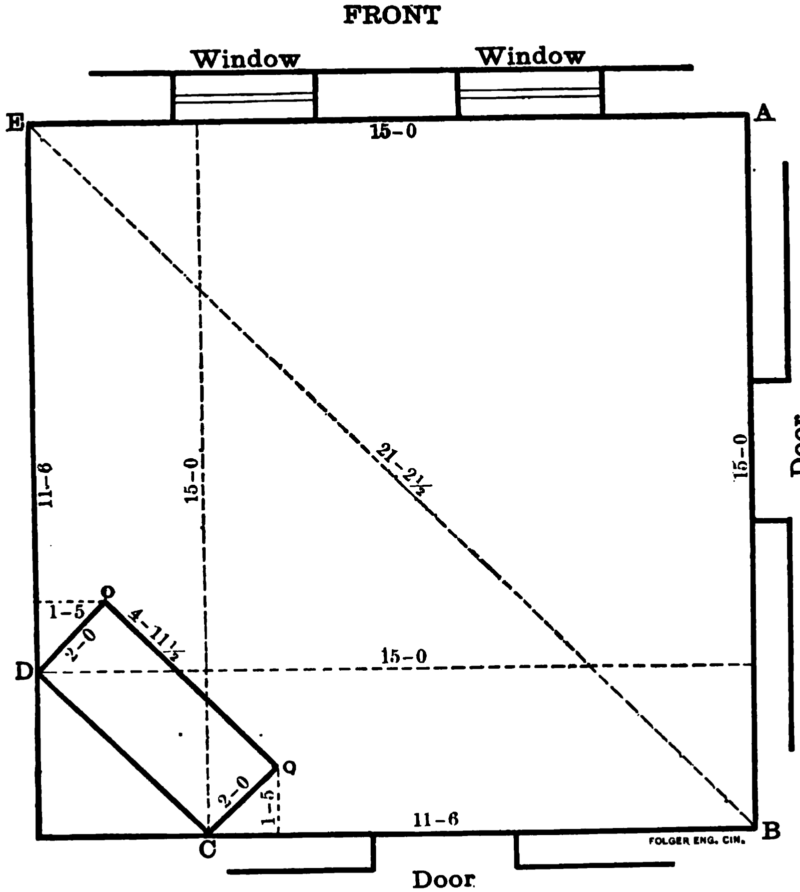


DIAGRAM 8.

DIAGRAM 9.

Let it be required to reproduce Diagram 9.

1. Draw the straight line A B equal to the given distance 7.11.

2. From B, with a radius of 5.0, describe an arc at C.

3. From A, with a radius of 11.11⅞, describe an arc cutting the former in C; through this intersection draw the straight line C B.

4. From C, with a radius of 7.11, describe an arc at D.

5. From A, with a radius of 16.2½, describe an arc cutting the former in D; through this intersection draw the straight line D C.

6. From D, with a radius of 5.0, describe an arc at E.

7. From B, with a radius of 15.0, describe an arc cutting the former in E; through this intersection draw the straight line E D.

8. From A, with a radius of 5.0, describe an arc at H.

9. From C, with a radius of 15.0, describe an arc cutting the former in H; through this intersection draw the straight line H A.

10. From H, with a radius of 7.11, describe an arc at G.

11. From D, with a radius of 15.0, describe an arc cutting the former in G; through this intersection draw the straight line G H.

12. From G, with a radius of 5.0, describe an arc at F.

13. From A, with a radius of 15.0, describe an arc

FRONT

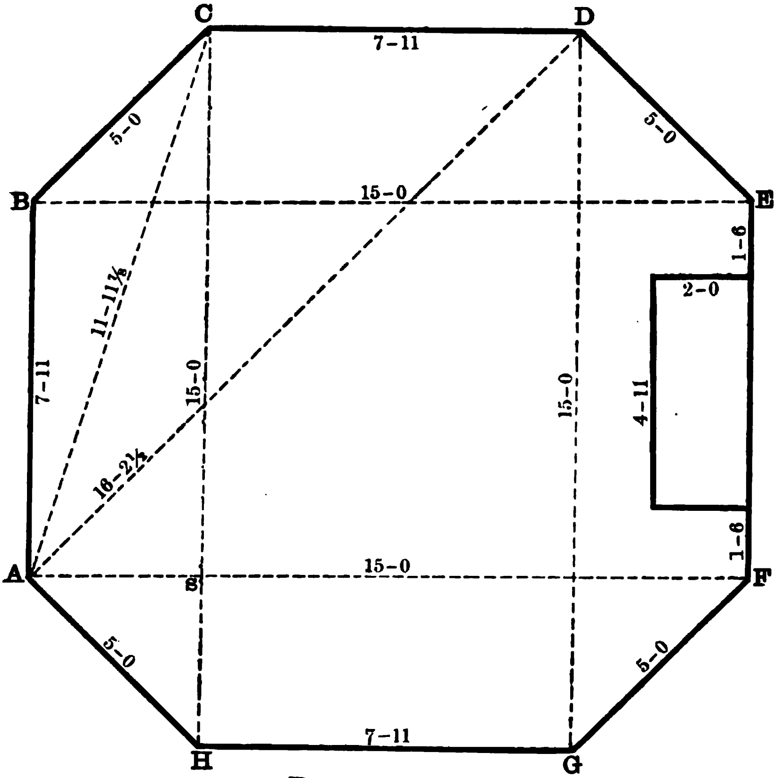
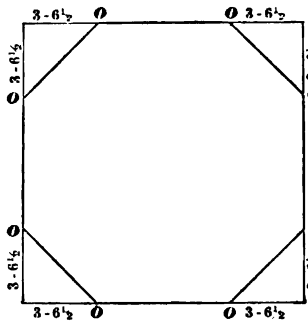


DIAGRAM 9.

cutting the former in F; through this intersection draw the straight line F G; join F E through the points F and E, which will measure 7.11, and on this straight line establish the position of fire-place in the points o and o at right angles and equal to the given distances,—which will complete the diagram as required.

Another method of describing the above diagram, without the aid of the diagonal lengths, is to construct a right-angled square equal to the extreme length and width of room, which is 15.0 by 15.0; then take the difference between 7.11 and 15.0, which is 7.1; the ½ of 7.1 is 3.6½; then, from each corner of the square, and at right angles, measure off 3.6½ to the letters o (see diagram above); join these points by straight lines; and these various lengths will measure 5.0 each. It is very seldom that a room has all its angles equal, as in this diagram, as there is more or less variation, due to faulty construction or some other cause. It is therefore advisable, in all cases, to get the diagonals, as shown in Diagrams 8 and 9. Without the diagonals in Diagram 9, the room can not be accurately constructed, unless by chance.



All the measurements should be given from the various points as indicated in diagram, to insure a correct diagram.

DIAGRAM 10.

Let it be required to reproduce Diagram 10.

1. Draw the straight line A B equal to the given distance 8.6.

2. From A, with a radius of $5.0\frac{7}{8}$, describe an arc at H.

3. From B, with a radius of $12.10\frac{5}{8}$, describe an arc cutting the former in H; through this intersection draw the straight line H A.

4. From H, with a radius of $8.0\frac{7}{8}$, describe an arc at G.

5. From B, with a radius of $16.6\frac{3}{4}$, describe an arc cutting the former in G; through this intersection draw the straight line G H.

6. From G, with a radius of $5.3\frac{7}{8}$, describe an arc at F.

7. From A, with a radius of $14.8\frac{5}{8}$, describe an arc cutting the former in F; through this intersection draw the straight line F G.

8. From F, with a radius of 8.0, describe an arc at E.

9. From B, with a radius of $14.11\frac{3}{4}$, describe an arc cutting the former in E; through this intersection draw the straight line E F.

10. From B, with a radius of $5.2\frac{1}{2}$, describe an arc at C.

11. From H, with a radius of $16.3\frac{7}{8}$, describe an arc cutting the former in C; through this intersection draw the straight line C B.

12. From C, with a radius of 7.6, describe an arc at D.

13. From G, with a radius of 15.11⅞, describe an arc cutting the former in D; through this intersection draw the straight line D C; join D E through the points D and E, which will be found to measure 5.7¼, and on this line establish the position of fire-place. Thus: From D and E mark off 6 inches to **o o**; then, from the points **o** and **o**, with a radius of 2.4 and 2.3, describe arcs at **x** and **x**; draw 2.0 parallel to C D, and 1.11 parallel with F E, intersecting the arcs in **x** and **x**; join **o x** and **x x**; then will the distance from **x** to **x** measure 4.7¼,—which completes the diagram as required.

FRONT

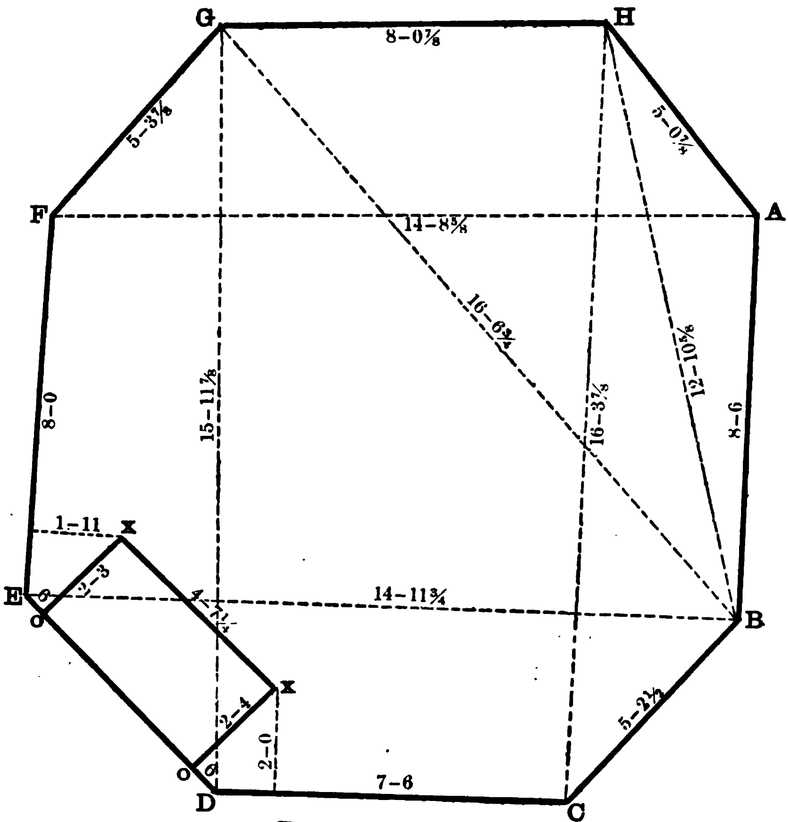


DIAGRAM 10.

DIAGRAM 11.

Let it be required to reproduce Diagram 11.

1. Draw the straight line from A to D indefinitely

2. From A lay off 15.0 to B; B to C, 1.3; C to D, 15.0.

3. From A, with a radius of 15.0, describe an arc at J.

4. From B, with a radius of 21.2½, describe an arc cutting the former in J; through this intersection draw the straight line J A continuously.

5. From A lay off 3.6 to R; R to K, 8.0; then will the distance from K to J measure 3.6.

6. From the points R and K erect R P and K L perpendicular to A J, and equal to the given distance of 1.0.

7. Draw M N parallel with A J indefinitely, and equal to the given distance of 3.1½.

8. From the points P and L, with a radius of 3.0, describe arcs cutting the indefinite straight line M N in the points M and N; through these intersections draw the straight lines M L and N P; then will the distance from M to N measure 3.9⅛.

9. From B, with a radius of 15.0, describe an arc at I.

10. From A, with a radius of 21.2½, describe an arc cutting the former in I; through this intersection draw the straight line I B continuously; also join I J, which will be found to measure 15.0; and on this straight line establish the position of the fire-place

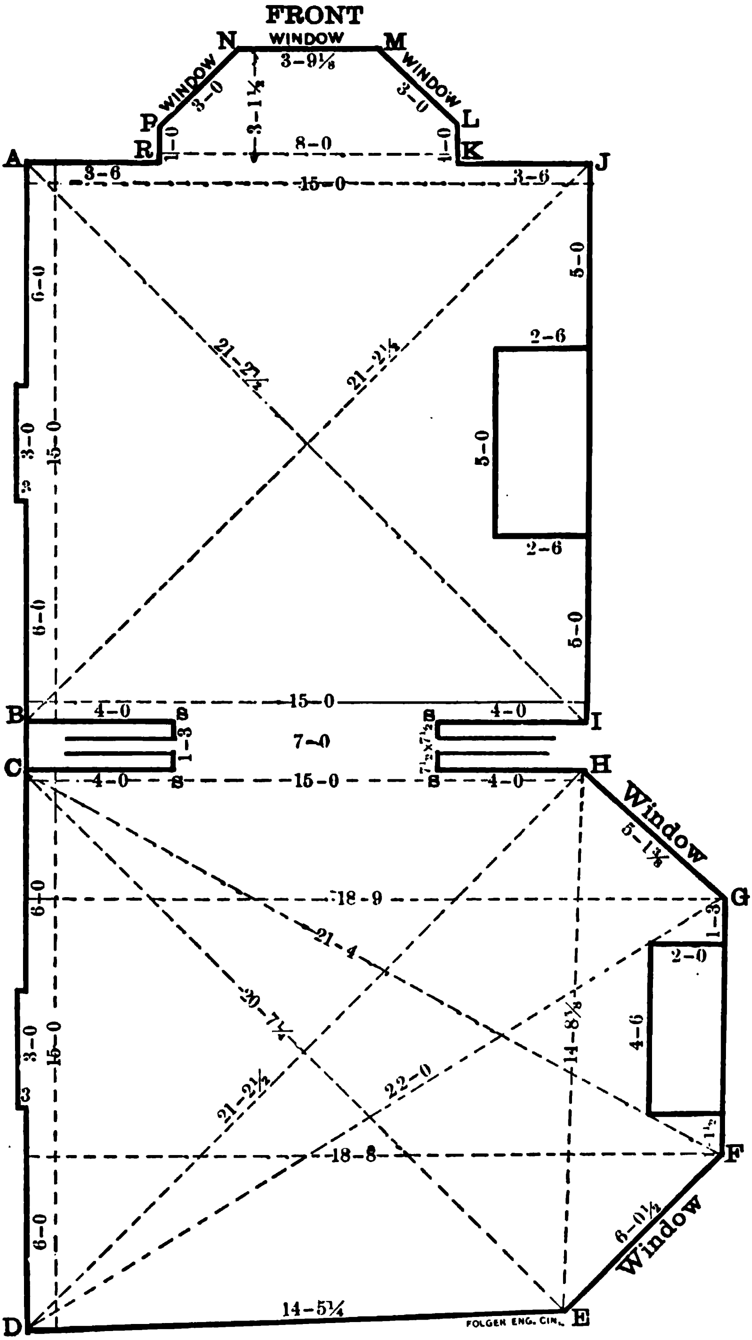

FRONT
WINDOW
3-9⅛
WINDOW
3-0
WINDOW
3-0
3-1½
8-0
1-0
1-0
3-6
15-0
3-6
A
N
M
P
L
R
K
J
5-0
2-6
21-2¼
21-2¼
6-0
3-0
15-0
5-0
2-6
6-0
5-0
15-0
B
I
4-0
4-0
1-3
7-0
C
H
4-0
15-0
4-0
Window
5-1⅜
G
18-9
21-4
1-3
2-0
20-7¼
14-8⅜
4-6
6-0
3-0
15-0
21-2½
22-0
F
18-8
6-0
6-0½
Window
14-5¼
D
E
FOLGER ENG. CIN.

DIAGRAM 11.

equal to the given distances, as shown in the preceding diagrams.

11. From C, with a radius of 15.0, describe an arc at H.

12. From D, with a radius of 21.2½, describe an arc cutting the former in H; through this intersection draw the straight line H C continuously, and it will be found to be parallel to B I and at a distance of 1.3 apart; then on these straight lines locate the opening of the double door.

13. From D, with a radius of 14.5¼, describe an arc at E.

14. From C, with a radius of 20.7¼, describe an arc cutting the former in E; through this intersection draw the straight line E D.

15. From E, with a radius of 6.0½, describe an arc at F.

16. From C, with a radius of 21.4, describe an arc cutting the former in F; through this intersection draw the straight line F E.

17. From H, with a radius of 5.1⅜, describe an arc at G.

18. From D, with a radius of 22.0, describe an arc cutting the former in G; through this intersection draw the straight line G H; join F G, which will be found to measure 6.10½; then will the perpendiculars on the straight line C D, and opposite the points F and G, measure 18.8 and 18.9 respectively; also, the distance from the points H to E will be found to measure 14.8⅝.

19. On the straight line F G locate the position of the fire-place equal to the given distances, as already shown in the preceding pages; also locate the position of the two door-openings on the straight line A D,—which completes the diagram as required.

NOTE.—It will be observed that the rear parlor is not right-angled.

DIAGRAM 12.

Let it be required to reproduce Diagram 12.

1. Draw the straight line A B equal to the given distance 15.0.

2. From A, with a radius of 9.11¼, describe an arc at E.

3. From B, with a radius of 17.11½, describe an arc cutting the former in E; through this intersection draw the straight line E A.

4. From E, with a radius of 7.1¾, describe an arc at D.

5. From B, with a radius of 18.0¼, describe an arc cutting the former in D; then will this point of intersection establish the opening of the circular window from E to D; and from the point of intersection at D, with a radius of 10.0, describe an arc at C.

6. From A, with a radius of 21.3, describe an arc cutting the former in C; through the points of intersection at C and D draw the straight line C D; join B C, and this distance will be found to measure 15.9; and on this straight line establish the position of the fire-place.

7. On the straight line A B lay off 10.0 from the point B towards A; then will this point be opposite D, and the distance from this point to D will be found to measure 15.0⅜.

8. From the point E, with a radius of 7.0, describe an arc at s; and from the point D, with a radius of

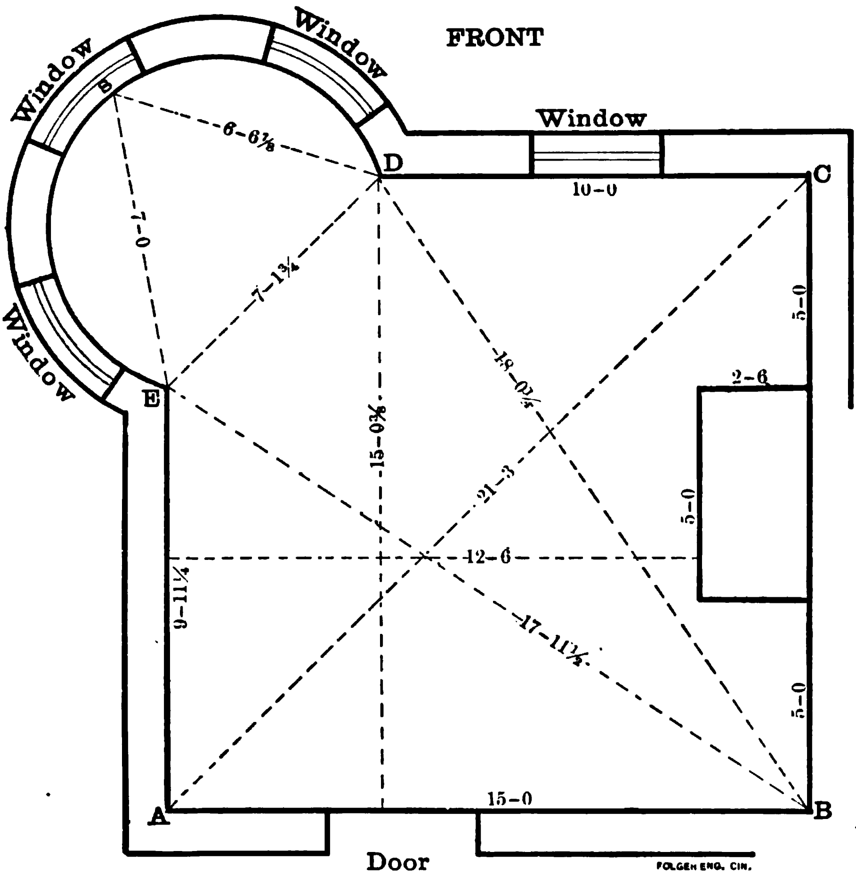

FRONT
Window
Window
Window
Window
D
C
E
A
B
S
6–6⅛
7–0
7–1¾
10–0
5–0
2–6
5–0
18–0¼
21–3
15–0⅜
12–6
9–11¼
17–11½
5–0
15–0
Door
FOLGER ENG. CIN.

DIAGRAM 12.

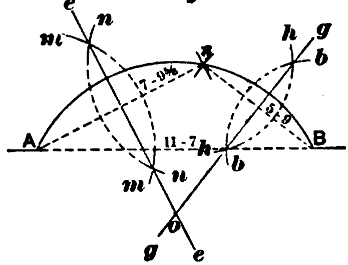
6.6$\frac{7}{8}$, describe another arc cutting the former in **s**; through this intersection draw the straight lines **s** E and **s** D; bisect these lines, as shown in Problem 1, and where they intersect each other will be the center from which to describe the circumference from E to D; and the radius will be found to be 4.0.

NOTE.—This method of describing an arc of a circle is on the same principle as shown in Problem 12, page 25. It is not only correct, but of such simple construction and so saving of time in measuring and reproducing the space, that it should be universally adopted by carpet upholsterers.

For the benefit of those who are not conversant with this method, we herewith give a more detailed explanation.

Let Figure 1 be a part of a circumference, and let this circumference represent a part of a circular window. Now, to get the measurements of this circular window so as to be able to reproduce it, you should first locate a point in the circumference at any convenient place, by making a small pencil-mark on the skirting of the base-board. Let *s* represent this point. Now, get the distance from A to *s*, which is found to be 7.9$\frac{5}{8}$; from B to *s*, 5.9; and from A to B, 11.7. These are all the measurements required, if the circle is true.

Fig. 1.



To describe the circle from these measurements,

first draw an indefinite chalk-line, and upon it lay off 11.7, the distance from A to B, which will be the opening of the window. From A, with a radius of $7.9\frac{5}{8}$, describe an arc at *s;* and from B, with a radius of 5.9, describe another arc cutting the former arc in *s*. Place a tack at each of the points A and B, also in the intersection at *s;* then, placing the ring of the tape-line on the projecting tack at A, and with any convenient length as a radius greater than one-half the distance from A to *s*, describe an arc of a circle, as *m m*. Next, place the ring of the tape-line on the projecting tack at *s;* then, with the same length as a radius that was required to describe the arc *m m*, describe the arc *n n*. Through the intersections of these arcs draw the indefinite straight line *e e*. From the points *s* and B describe the arcs *h h* and *b b*, and draw the straight line *g g*, performing the operation in the same manner as has been done from the points A and *s*. Where the straight lines *e e* and *g g* intersect each other in *o*, is the center from which to describe the circle; and the radius will be found to be $6.5\frac{3}{4}$.

It will be observed that the straight lines *e e* and *g g* are perpendicular, or at right angles, with the straight lines A *s* and B *s*. If they were not, the circle could not be described through the points A *s* B. It does not require any certain length in describing the arcs *m m*, *h h*, and *b b* from the points A *s* B, but the length should be greater than one-half the distance between A *s* and B *s*. To make this plainer, let *o o*, Figure 2, page 104, represent the distance from

A to *s*, and equal to $7.9\frac{5}{8}$; then, from the points *o* and *o*, with a length of 4.6 as a radius, describe the arcs $^{1\ 1}$. From the same points *o* and *o*, with a radius of 5.0, describe the arcs $^{2\ 2}$. Again, with a radius of 6.0, describe the arcs $^{3\ 3}$; and, with a radius of 8.0, the arcs $^{4\ 4}$. Now, in drawing the straight line *g g*, this will pass through each of the intersections of the various arcs; and if more arcs were produced, it would still pass through the intersections thus described. Hence it is evident, in describing the arcs, the length or radius does not require to be of a certain length, so it is greater than one-half the distance. The above demonstration shows the advantage and necessity of being conversant with plane, practical, geometrical problems.

Fig. 2.

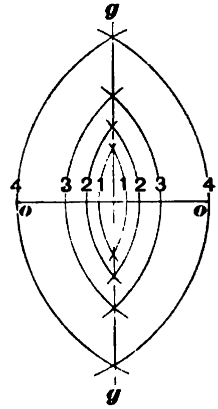


DIAGRAM 13.

Let it be required to reproduce Diagram 13.

1. Draw the straight line A B continuously and equal to the given distance 10.9.

2. From A, with a radius of 12.0, describe an arc at H.

3. From B, with a radius of 16.0⅜, describe an arc cutting the former in H; through this intersection draw H A.

4. From H, with a radius of 7.0¾, describe an arc at E.

5. From A, with a radius of 17.8⅞, describe an arc cutting the former in E; this point of intersection will establish the opening of the window; then will a perpendicular from the point E to the straight line A B measure 16.11¾.

6. From the point of intersection at E, with a radius of 9.5⅞ describe an arc at D.

7. From A, with a radius of 22.4½, describe an arc cutting the former in D; through this intersection draw D E.

8. From D, with a radius of 13.3, describe an arc at C.

9. From H, with a radius of 16.7⅞, describe an arc cutting the former in C; through this intersection draw C D continuously; then will the distance from the point H, to the straight line D C and parallel to E D, measure 14.5¾; and from the point C, to the

straight line A H and parallel to A B, will measure 14.6¼; join C B through the points C and B; then will this distance prove to be 5.3¾; and on this straight line locate the position of the fire-place at right angle with C B, and equal to the given distance.

10. From H, with a radius of 4.11¾, describe an arc at G.

11. From E, with a radius of 8.8, describe an arc cutting the former in G; through this intersection draw G H.

12. From G, with a radius of 7.0⅞, describe an arc at F.

13. From E, with a radius of 4.11⅝, describe an arc cutting the former in F; through this intersection draw the straight lines F G and F E; then will the distance from H to F measure 8.7⅝.

14. On the straight line F G locate the position of the window recess equal to the given distances in the diagram, as has already been described in preceding drawings,—which completes the diagram as required.

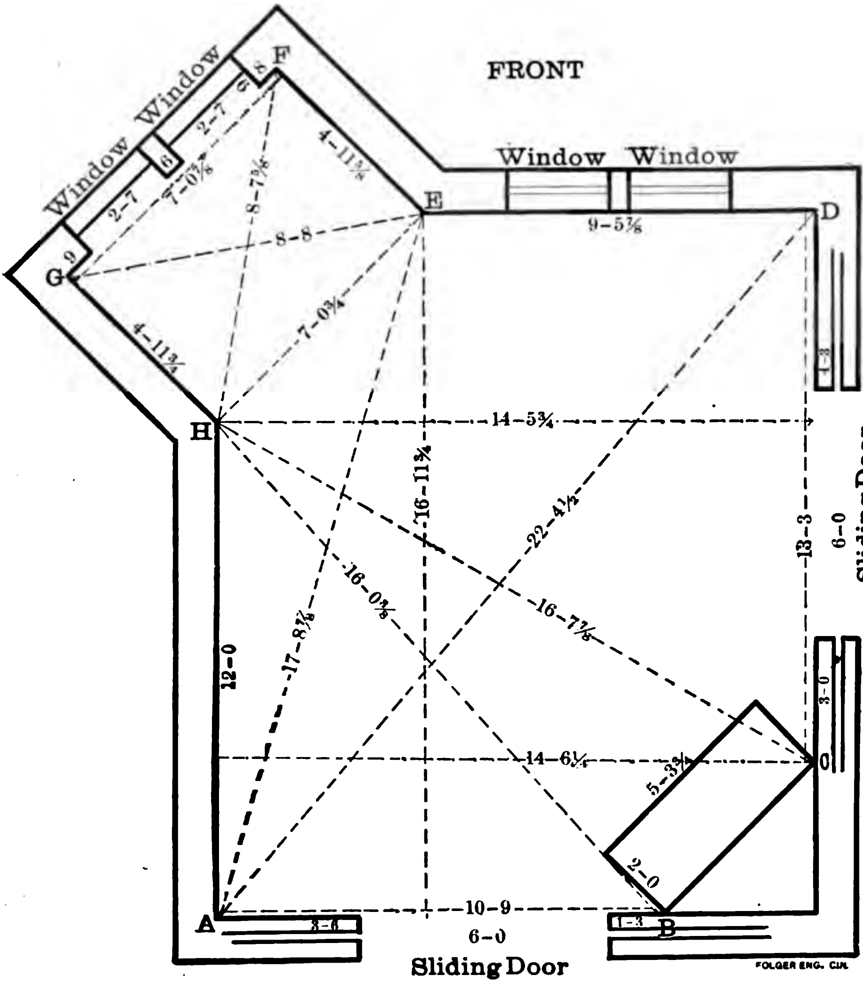

FRONT
Window
Window
Window
Window
Sliding Door
6-0
Sliding Door
6-0
A
B
D
E
F
G
H
12-0
14-5¾
14-6¼
16-11¾
17-8⅞
22-4½
16-0⅜
16-7⅞
13-3
10-9
9-5⅞
8-8
7-0¾
4-11¾
4-11⅞
2-7
2-7
5-3¾
2-0
3-6
1-3
3-0
FOLGER ENG. CIN.

DIAGRAM 13.

DIAGRAM 14.

Let it be required to reproduce Diagram 14.

1. Draw the straight line A B equal to given distance of 10.10⅛.

2. From A, with a radius of 10.2, describe an arc at L.

3. From B, with a radius of 14.10⅜, describe an arc cutting the former in L; through this intersection draw L A.

4. From L, with a radius of 7.6⅛, describe an arc at E.

5. From A, with a radius of 16.4⅝, describe an arc cutting the former in E; this point of intersection will locate the opening of the window; then will a perpendicular from the point E to the straight line A B measure 15.6⅛.

6. From the point of intersection at E, with a radius of 9.0, describe an arc at D.

7. From A, with a radius of 21.2, describe an arc cutting the former in D; through this intersection draw D E continuously, and on this line locate the position of the window recess equal to the given distances.

8. From D, with a radius of 12.0, describe an arc at C.

9. From L, with a radius of 15.10½, describe an arc cutting the former in C; through this intersection draw C D continuously; then will the distance from

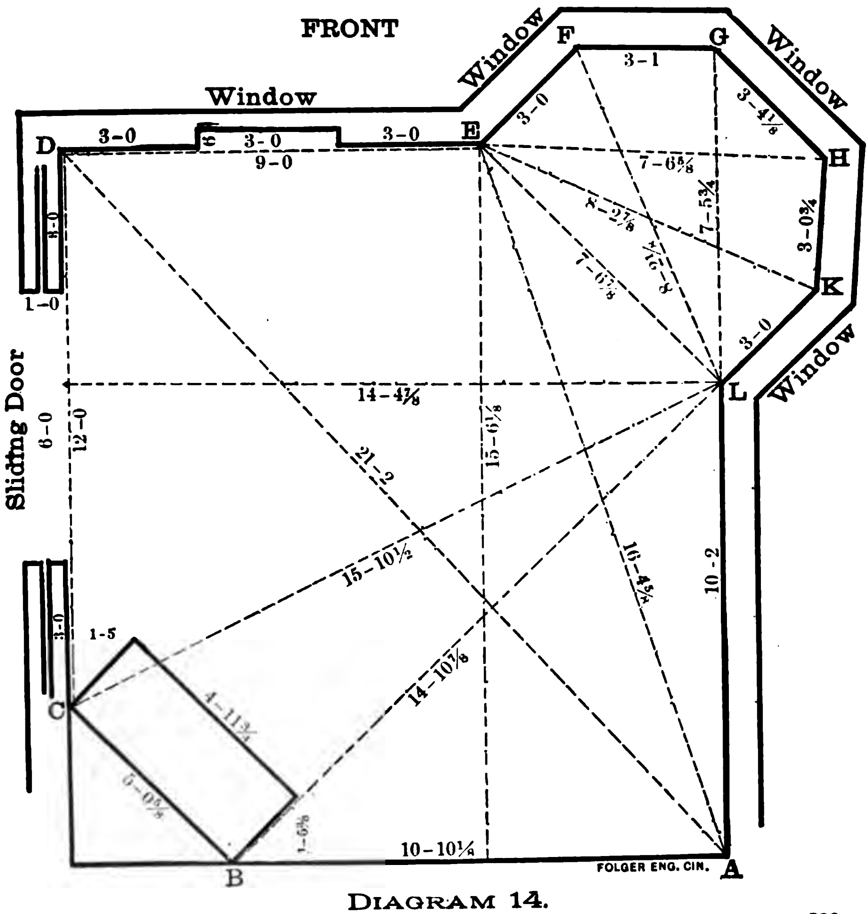

FRONT
Window
Window
Window
Window
Sliding Door
D
E
F
G
H
K
L
A
B
C
3-0
3-0
3-0
9-0
3-1
3-0
3-4⅛
7-6⅝
8-2⅞
7-6⅞
7-5¾
3-0¾
3-0
14-4⅞
12-0
6-0
1-0
21-2
15-6⅛
15-10½
14-10⅛
16-4¾
10-2
1-5
4-11¾
10-10⅛
FOLGER ENG. CIN.

DIAGRAM 14.

the point L to the straight line D C, and parallel to E D, measure 14.4⅞. Join C B through the points C and B, and this distance will prove to measure 5.0⅝; and on this straight line establish the position of the fire-place equal to the given distances, as has been shown in Diagrams 8 and 10. On the straight line D C locate the opening of the double doors.

10. From L, with a radius of 3.0, describe an arc at K.

11. From E, with a radius of 8.2⅞, describe an arc cutting the former in K; through this intersection draw K L.

12. From K, with a radius of 3.0¾, describe an arc at H.

13. From E, with a radius of 7.6⅝, describe an arc cutting the former in H; through this intersection draw H K.

14. From H, with a radius of 3.4⅛, describe an arc at G.

15. From L, with a radius of 7.5¾, describe an arc cutting the former in G; through this intersection draw G H.

16. From E, with a radius of 3.0, describe an arc at F.

17. From G, with a radius of 3.1, describe an arc cutting the former in F; through this intersection draw the straight lines F G and F E; then will the distance from L to F measure 8.2⅛,—which completes the diagram as required.

DIAGRAM 15.

Let it be required to reproduce Diagram 15.

1. Draw the straight line A B continuously and equal to the given distance 11 feet, 11 inches.

2. From A, with a radius of 12.0, describe an arc at L.

3. From B, with a radius of 16.11⅛, describe an arc cutting the former in L; through this intersection draw L A.

4. From L, with a radius of 4.7½ describe an arc at E.

5. From A, with a radius of 15.7½, describe an arc cutting the former in E; this point of intersection will locate the opening of the octagonal window; then will a perpendicular from the point E to the straight line A B measure 15.3½.

6. From E, with a radius of 12.4⅛, describe an arc at D.

7. From A, with a radius of 21.10⅜, describe an arc cutting the former in D; through this intersection draw D E.

8. From D, with a radius of 11.3¼, describe an arc at C.

9. From L, with a radius of 17.5⅜, describe an arc cutting the former in C; through this intersection draw C D continuously; then will the distance from the point L to the straight line D C, and parallel to E D, measure 15.7⅛; and from the point C to the

straight line A L, and parallel to A B, will measure 15.6¼. Join C B through the points C and B, then will this distance measure 5.5; and on this straight line locate the position of the fire-place as shown in the preceding diagrams.

10. From L, with a radius of 2.0, describe an arc at K.

11. From E, with a radius of 6.2⅜, describe an arc cutting the former in K; through this intersection draw K L.

12. From K, with a radius of 3.1¼, describe an arc at J.

13. From E, with a radius of 7.6¾, describe an arc cutting the former in J; through this intersection draw J K.

14. From J, with a radius of 3.1⅛, describe an arc at I.

15. From L, with a radius of 6.9⅛, describe an arc cutting the former in I; through this intersection draw I J.

16. From E, with a radius of 2.0, describe an arc at F.

17. From K, with a radius of 7.5¾, describe an arc cutting the former in F; through this intersection draw F E.

18. From F, with a radius of 3.1⅞, describe an arc at G.

19. From J, with a radius of 7.6½, describe an arc cutting the former in G; through this intersection draw G F.

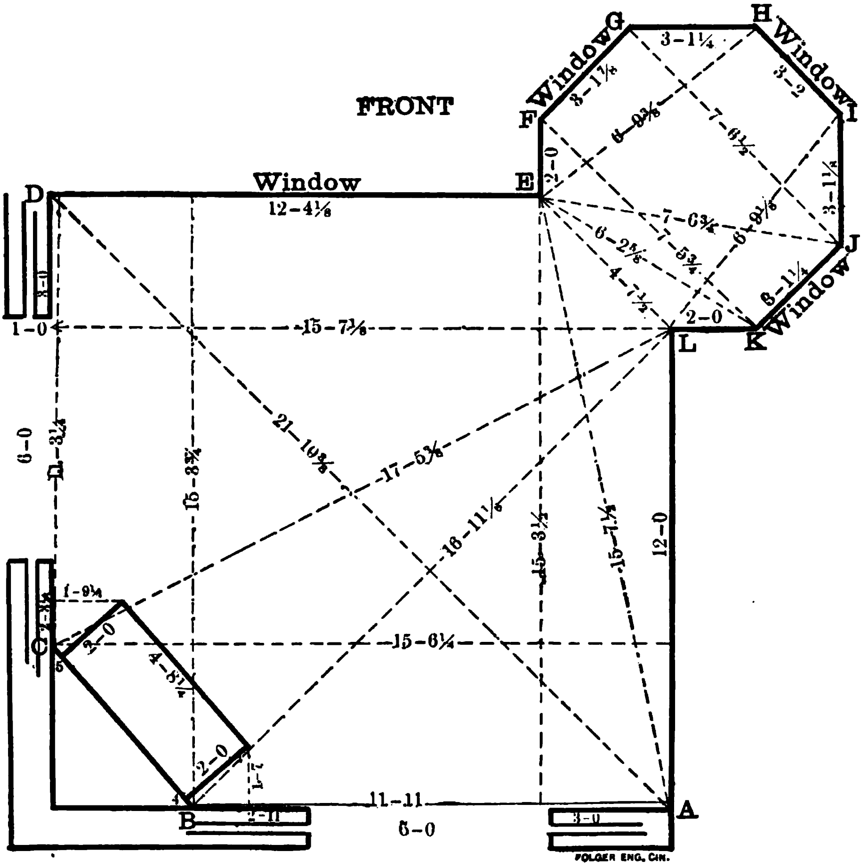

FRONT
Window
12-4⅛
D
E
F
G
H
I
J
K
L
A
B
C
Window
Window
Window
Window
3-1¼
3-2
3-1⅛
2-0
15-7⅛
1-0
6-0
12-0
11-11
6-0
3-0
2-0
4-8½
15-6¼
15-8¾
15-3½
15-7⅛
16-11⅛
17-5⅜
21-10⅝
7-6¾
6-2⅝
4-7¼
7-5¾
7-6½
FOLGER ENG. CIN.

DIAGRAM 15.

20. From G, with a radius of 3.1¼, describe an arc at H.

21. From E, with a radius of 6.9⅜, describe an arc cutting the former in H; through this intersection draw H G. Join H I; then will the distance from H to I prove to measure 3.2,—which completes the diagram as required.

DIAGRAM 16.

Let it be required to reproduce Diagram 16.

1. Draw the straight line A B equal to the given distance 11.5.

2. From B, with a radius of $16.9\frac{5}{8}$, describe an arc at C.

3. From A, with a radius of 20.3, describe an arc cutting the former in C; through this intersection draw C B continuously, and on this straight line locate the opening of the sliding doors equal to the given distances.

4. From C, with a radius of $10.8\frac{3}{4}$, describe an arc at D.

5. From B, with a radius of $19.11\frac{1}{4}$, describe an arc cutting the former in D; through this intersection draw D C; then will the distance from the point D to the point A measure $16.8\frac{7}{8}$.

6. From D, with a radius of 6.0, describe an arc at H.

7. From B, with a radius of $19.7\frac{1}{8}$, describe an arc cutting the former in H; then will this point of intersection establish the opening of the circular window; also will the distance from the point H to the straight line C B, and parallel to C D, measure $15.0\frac{1}{8}$.

8. From H, with a radius of $9.0\frac{3}{8}$, describe an arc at I.

9. From C, with a radius of $19.11\frac{3}{4}$, describe an arc cutting the former in I; through this intersection

draw H I; then will the distance from the point I to the straight line B C, and parallel to A B, measure 14.11⅞. Join I A through the points I and A, and on this straight line locate the position of the fire-place equal to the given distances, as has been shown in Diagrams 8 and 10.

10. From H, with a radius of 2.0½, describe an arc at G.

11. From D, with a radius of 6.3⅛, describe an arc cutting the former in G; through this intersection draw G H.

12. From D, with a radius of 2.0⅜, describe an arc at E.

13. From H, with a radius of 6.4¼, describe an arc cutting the former in E; through this intersection draw E D.

14. From G, with a radius of 7.1⅛, describe an arc at F.

15. From E, with a radius of 8.3¾, describe an arc cutting the former in F; through this point of intersection draw straight lines, as F G and F E; bisect these lines, as in Problem 1, and where they intersect each other, as shown in Problem 12, will be the center, from which point can be described the circumference of the given circle through the points E F and G,—which completes the diagram as required.

NOTE.—This circular window is constructed in the same manner as shown in Diagram 12.

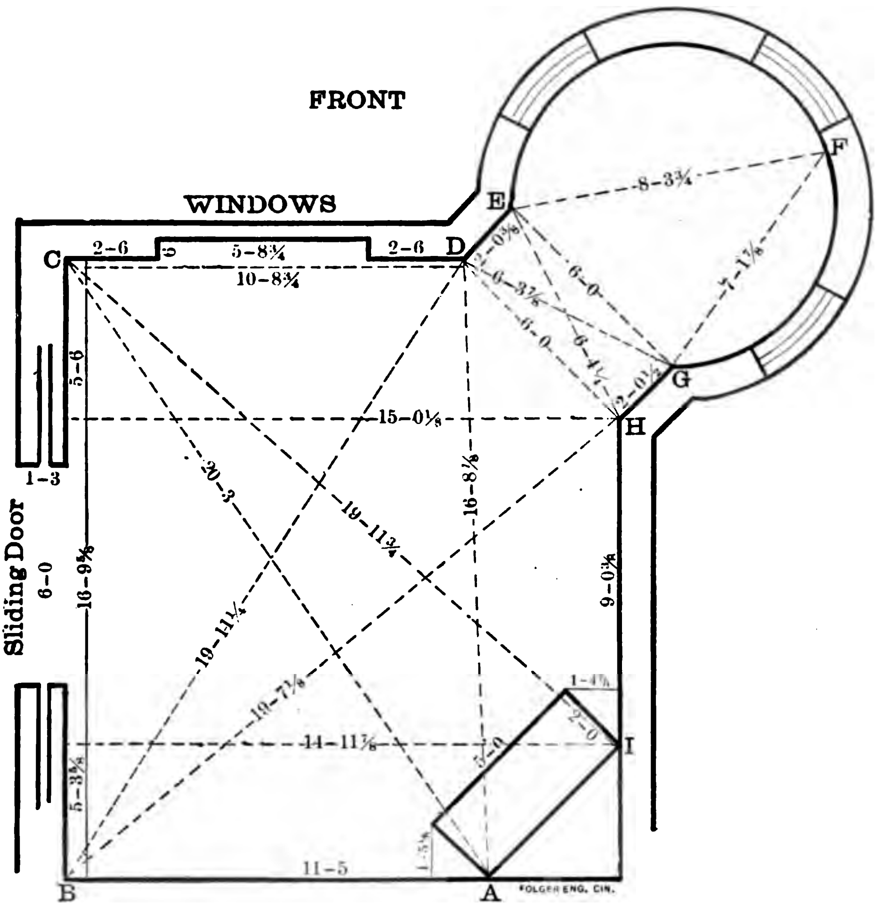

FRONT
WINDOWS
C
2-6
5-8¾
2-6
D
10-8¾
E
8-3¾
F
2-0⅜
6-0
7-1⅞
6-3⅞
6-0
6-4¼
G
2-0½
H
5-6
15-0⅛
1-3
Sliding Door
6-0
16-9⅝
20-3
19-11¾
16-8⅛
9-0⅜
19-11¼
19-7⅞
1-4⅞
2-0
14-11⅞
3-0
I
5-3⅝
11-5
B
A
FOLGER ENG. CIN.

DIAGRAM 16.

DIAGRAM 17.

Let it be required to reproduce Diagram 17.

1. Draw the straight line A B equal to the given distance 11.11⅞.

2. From A, with a radius of 14.10, describe an arc at F.

3. From B, with a radius of 19.1⅛, describe an arc cutting the former in F; then will this point of intersection be the width of the room from A to F.

4. From B, with a radius of 4.7, describe an arc at C.

5. From F, with a radius of 19.2⅛, describe an arc cutting the former in C; through this intersection draw C B.

6. From C, with a radius of 8.3⅛, describe an arc at D.

7. From A, with a radius of 19.0⅞, describe an arc cutting the former in D; through this intersection draw D C.

8. From D, with a radius of 4.7⅛, describe an arc at E.

9. From A, with a radius of 18.11⅝, describe an arc cutting the former in E; through this intersection draw E D; then will the distance from the point B to the point E measure 14.8⅞, and from E to F 11.11¾. Join E F, and on this straight line locate the position of the fire-place.

10. From A, with a radius of 8.0, describe an arc

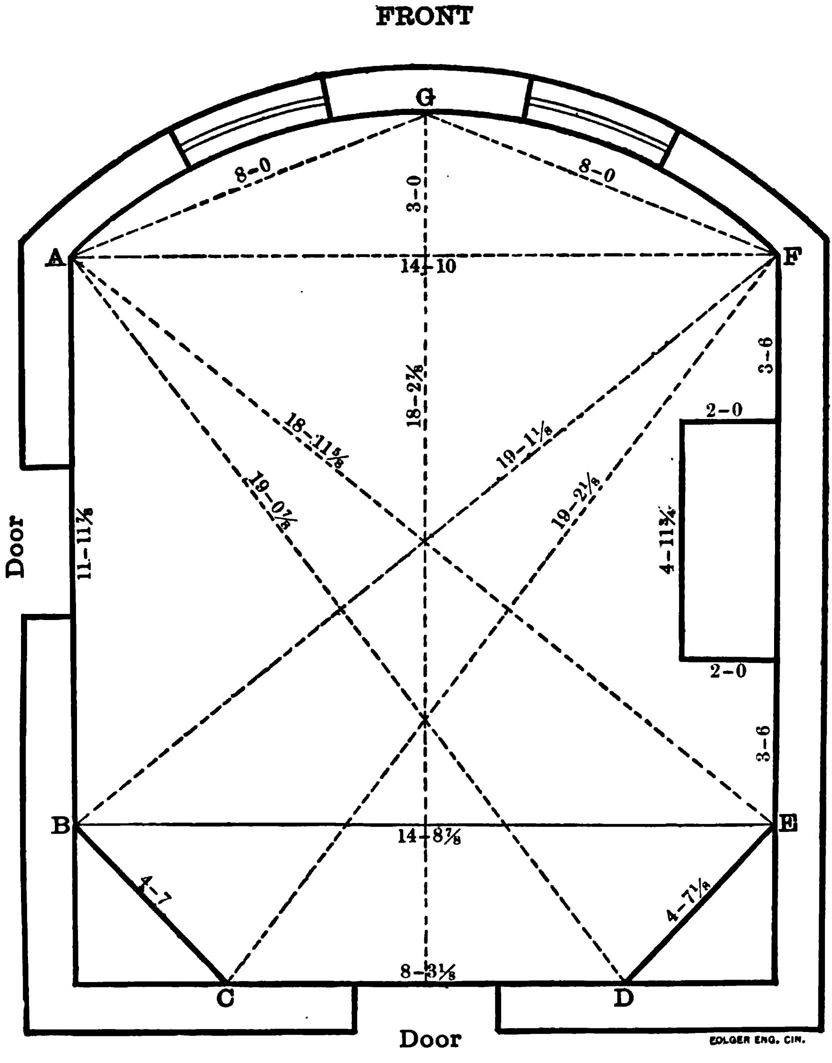

FRONT
G
8-0
8-0
3-0
A
F
14-10
18-2⅞
3-6
2-0
18-11⅝
19-1⅛
19-0⅞
19-2⅛
Door
11-11⅞
4-11¾
2-0
3-6
B
E
14-8⅞
4-7
4-7⅛
8-3⅛
C
D
Door
FOLGER ENG. CIN.

DIAGRAM 17.

at G; and from F, with a radius of 8.0, describe another arc cutting the former in G; then will a perpendicular from the straight line C D to the intersection at G measure $18.2\frac{7}{8}$. Through the intersection at G, draw straight lines, as G A and G F; bisect these lines, as in Problem 1, and where these lines intersect each other, as shown in Problem 12, will be the center, from which point can be described the segment of the circle through the points A G F,—which completes the diagram as required.

DIAGRAM 18.

Let it be required to reproduce Diagram 18.

1. Draw the straight line A B equal to the given distance 16.0.

2. From B, with a radius of 15.0, describe an arc at C.

3. From A, with a radius of 21.10$\frac{5}{8}$, describe an arc cutting the former in C; through this intersection draw C B continuously, and on this straight line locate the opening of the sliding doors.

4. From C, with a radius of 9.6$\frac{1}{8}$, describe an arc at D.

5. From B, with a radius of 17.9$\frac{1}{2}$, describe an arc cutting the former in D; through this intersection draw D C; then will the distance from the point D to the straight line A B, and parallel to C B, measure 15.0.

6. From A, with a radius of 10.4$\frac{3}{4}$, describe an arc at F.

7. From B, with a radius of 19.0$\frac{5}{8}$, describe an arc cutting the former in F; then will this point of intersection establish the width of the room from A to F.

8. From F, with a radius of 2.5$\frac{7}{8}$, describe an arc at E.

9. From B, with a radius of 17.0$\frac{1}{4}$, describe an arc cutting the former in E; through this intersection draw E F; then will the distance from the point E

to the straight line A B, and parallel to C B, measure 10.4¾. Join E D, and this distance will prove to measure 6.0½, and on this straight line establish the position of the fire-place equal to the given distances.

10. From A, with a radius of 5.9⅛, describe an arc at G.

11. From F, with a radius of 5.9¼, describe an arc cutting the former in G; through this intersection draw the straight lines G A and G F; bisect these lines by perpendiculars, as in Problem 1, and where these perpendiculars intersect each other, as shown in Problem 12, will be the center, from which point can be described the segment of the circle through the points A G F,—which completes the diagram as required.

FRONT

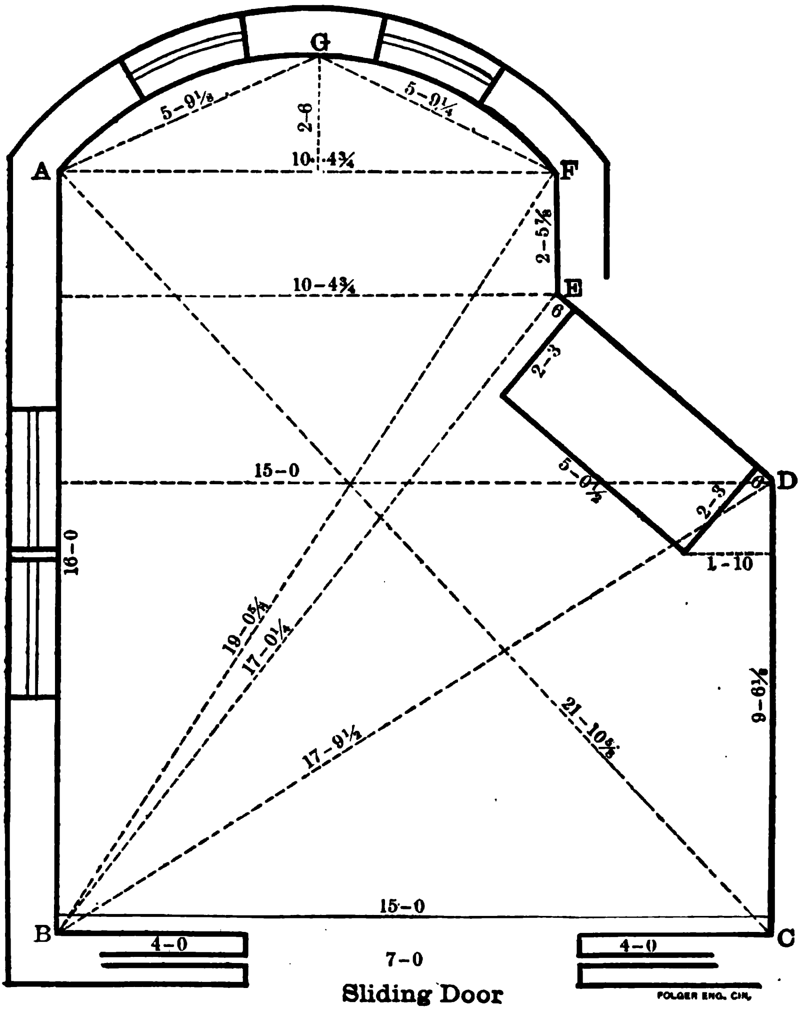


DIAGRAM 18.

DIAGRAM 19.

Let it be required to reproduce Diagram 19.

1. Draw the straight line A B equal to the given distance 14.0.

2. From B, with a radius of 15.3¼, describe an arc at E.

3. From A, with a radius of 20.8¾, describe an arc cutting the former in E; then will this point of intersection establish the width of the room from B to E.

4. From A, with a radius of 6.3, describe an arc at **s**.

5. From B, with a radius of 15.4, describe an arc cutting the former in **s**; through this intersection draw the straight line **s** A, produced beyond **s**.

6. From A lay off 6.8, which is the distance from A to **x**.

7. From **x**, with a radius of 2.5, describe an arc at G.

8. From E, with a radius of 18.6⅜, describe an arc cutting the former in G; through this intersection draw G **x**, and on this straight line, from the point G measure off 2.0 to **o**; then, from the point **o** to the point **s**, trace the curve **o s**.

9. From G, with a radius of 8.7½, describe an arc at F.

10. From B, with a radius of 22.5¼, describe an arc cutting the former in F; through this intersection draw F G.

11. Join E F through the points F and E, and on

FRONT

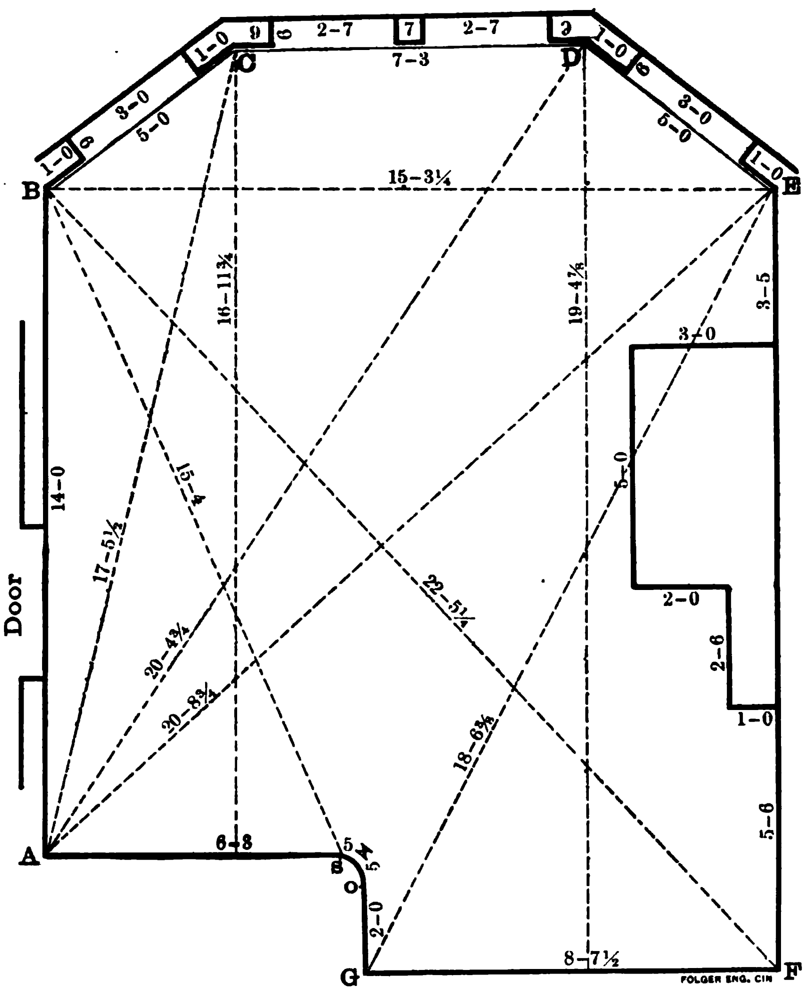


DIAGRAM 19.

this straight line locate the position of the fire-place equal to the given distances.

12. From B, with a radius of 5.0, describe an arc at C.

13. From A, with a radius of 17.5½, describe an arc cutting the former in C; through this intersection draw C B continuously; then will a perpendicular from the point C to the straight line A s measure 16.11¾.

14. From C, with a radius of 7.3, describe an arc at D.

15. From E, with a radius of 5.0, describe an arc cutting the former in D; through this point of intersection draw the straight lines D E and D C continuously; then will the distance from A to D measure 20.4¾, and a perpendicular drawn from the point D to the straight line F G will measure 19.4⅞.

16. On the straight lines B C, C D, and D E, locate the position of the window recess equal to the given distance as shown,—which completes the diagram as required.

DIAGRAM 20.

Let it be required to reproduce Diagram 20.

1. Draw the straight line A B equal to the given distance 6.0.

2. From B, with a radius of 15.0, describe an arc at G.

3. From A, with a radius of 16.1⅞, describe an arc cutting the former in G.

4. From G, with a radius at 6.0, describe an arc at H.

5. From A, with a radius of 15.0, describe an arc cutting the former in H; these points of intersection will then locate the square or rectangle A B G H.

6. From H, with a radius of 8.2, describe an arc at I.

7. From A, with a radius of 12.6⅞, describe an arc cutting the former in I.

8. From A, with a radius of 8.2, describe an arc at L.

9. From H, with a radius of 12.6⅞, describe an arc cutting the former in L; then will the distance through these points of intersection from I to L measure 6.1⅛.

10. From the points I and L draw the perpendiculars I J and L K equal to the given distances of 1.4½. Join K J.

11. Join A L and H I; bisect these lines, as in Problem 1, and where these perpendiculars intersect each

other, as shown in Problem 12, will be the center, from which can be described the circle through the points A L I H.

12. From B, with a radius of 6.4$\frac{3}{4}$, describe an arc at D.

13. From G, with a radius of 11.3$\frac{3}{8}$, describe an arc cutting the former in D.

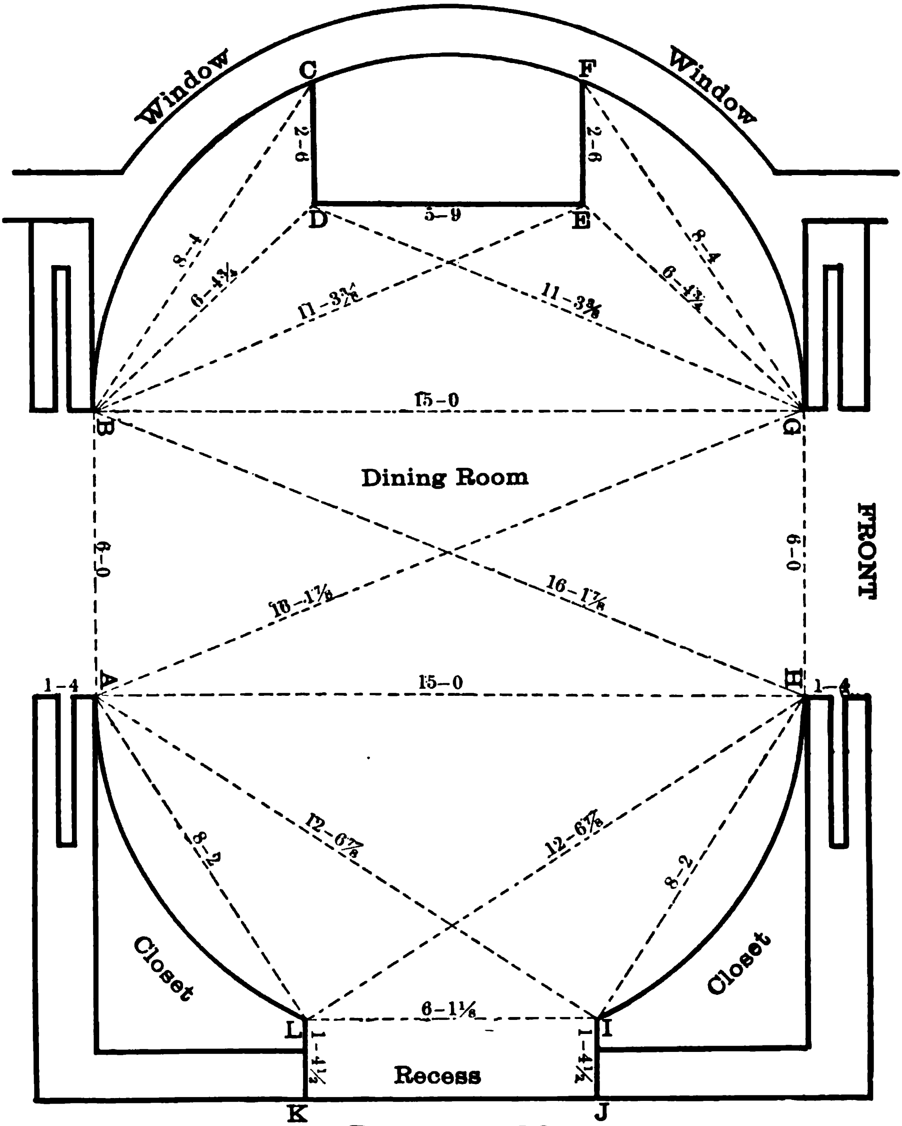
14. From G, with a radius of 6.4$\frac{3}{8}$, describe an arc at E.

15. From B, with a radius of 11.3$\frac{3}{8}$ describe an arc cutting the former in E; through the points of intersection at D and E draw the straight line D E.

16. From the points D and E, with a radius of 2.6, describe arcs at C and F.

17. From the points B and G, with a radius of 8.4, describe arcs cutting the former arcs in the points C and F. Join C D and E F.

18. Join B C and F G; bisect these straight lines, as shown in Problem 1, and where these perpendiculars intersect each other, as shown in Problem 12, will be the center, from which can be described the circle through the points B C F and G,—which completes the diagram as required.



Window
Window
C
F
2-6
2-6
D
E
5-9
8-4
6-4¾
11-3⅞
11-3⅞
6-4¾
8-4
15-0
B
G
Dining Room
FRONT
6-0
6-0
16-1⅞
16-1⅞
1-4
A
15-0
H
1-4
12-6⅞
12-6⅞
8-2
8-2
Closet
Closet
6-1⅛
L
I
1-4½
1-4½
Recess
K
J

DIAGRAM 20.

DIAGRAM 21.

Diagram 21 is a reception-hall and parlor. For those with limited experience, we would suggest to reproduce these rooms, as demonstrated in the preceding pages.

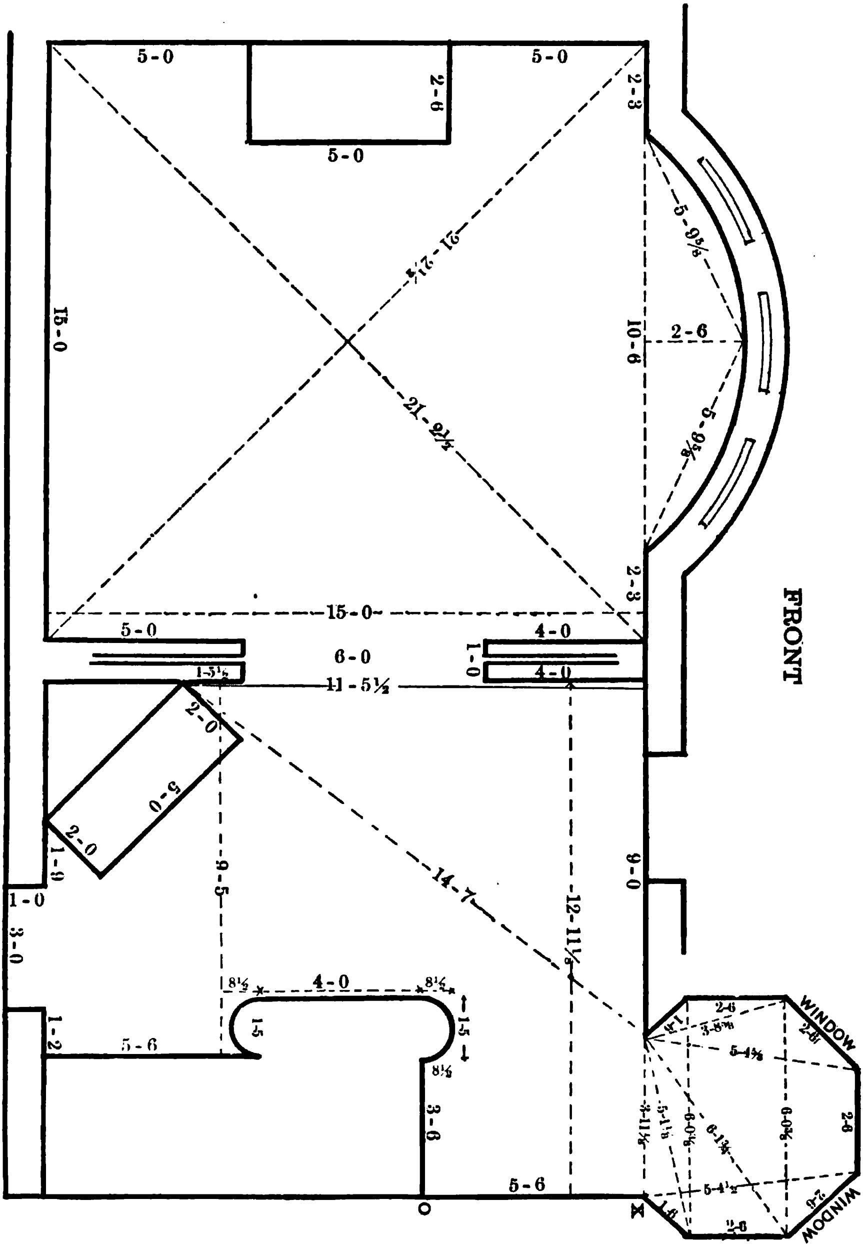

FRONT
WINDOW
WINDOW
15-0
6-0
11-5½
14-7
12-11⅛
9-0
5-6
4-0
FOLGER ENG. CIN

DIAGRAM 21.

NOTES AND SUGGESTIONS ON CUTTING,

RELATING TO RUNNING OF WIDTHS, FIGURES, SHADING, HOW BORDER SHOULD BE ARRANGED, ETC.

As THERE is no special rule for cutting carpets which will admit of mathematical demonstration on the same principle as shown in the preceding chapter in marking out and reproducing diagrams on floors, and to become an expert cutter requires time, practice, and judgment, we can, therefore, only give here a summary, which beginners and those desiring to acquire a knowledge of this branch of the business will find valuable for their guidance.

In the first place, the cutter is supposed to understand thoroughly the art of measuring and marking out plans of rooms. He should know if the plans submitted are sufficiently correct to admit of cutting the carpet without risk of a misfit. In fact, he should know the value of each length and distance given.

As before stated, this requires judgment and observation; and a want of information on these points is frequently the cause of a positive loss to the merchant. We therefore give a few practical suggestions for the guidance of beginners and the inexperienced.

Before making an attempt to cut the carpet, the cutter should be able to answer the following questions:

1. Is the diagram correct, or sufficiently so to protect you and your employer? If you should detect

an error which can not be satisfactorily explained, or if you have any reason to suspect the correctness of the diagram, notify the proper parties of your discovery, and have them make the necessary correction; especially is this applicable to diagrams that customers bring with them.

2. In what direction should the seams or widths be run?

3. How many widths does it require?

4. On which side must the selvedge edge be placed, and on which end should the turn-down be made?

5. In which direction are the designs or figures to point; and if for pile fabrics—as Wilton, Moquette, Axminster, or Velvet—how do you get the proper shading?

6. If border is required, how should it be arranged?

7. In what manner to cut the carpet economically, to secure the best results, and to avoid unnecessary piecing and patching?

Let us apply the above questions to the various plans in this work.

As to the first question, we will presume that the diagrams are correct. The next question to consider is,—

In what direction should the widths be run?

This is not governed by any set rule; consequently there is more or less diversity of opinion. Some cutters insist upon running the widths parallel with the fire-place, irrespective of doors and windows; others, again, run the widths from front to rear,

independent of fire-place. The latter, with exceptional cases, is generally considered the proper way. The widths in Diagrams 1 to 22 should, in all cases, run from front to rear. The widths in Diagram 30, which has a bay-window at the front of the house, should by all means run from front to rear, even if the fire place be at the end instead of the side. Should the bay-window face the side, and the straight side 14.0 be the front of the house, it would be preferable to run the widths from front to rear. But should the room be 16, 18, or 20 feet instead of 14.0, run the widths into the bay-window. If this room should be situated in rear of a front room, or if light is received from the bay-window only, run the widths into the bay-window. Should the library and dining room (see Diagram 38) be of different patterns, it would be preferable to run the widths from front to rear in library, and at right angles, or the long way, in dining-room. The arrows in Diagrams 38, 39, 40, and 41 indicate the direction it would be most desirable to run the widths. In many cases, the direction in which to run the widths must be determined by the good taste and judgment of the cutter, according to the conditions presented.

The next question to consider is,—

How many widths does it require?

As this question is easy of solution in most cases, it will be unnecessary to comment on it, further than to suggest that when a room measures very near an even number of widths, or parts of widths, the cutter

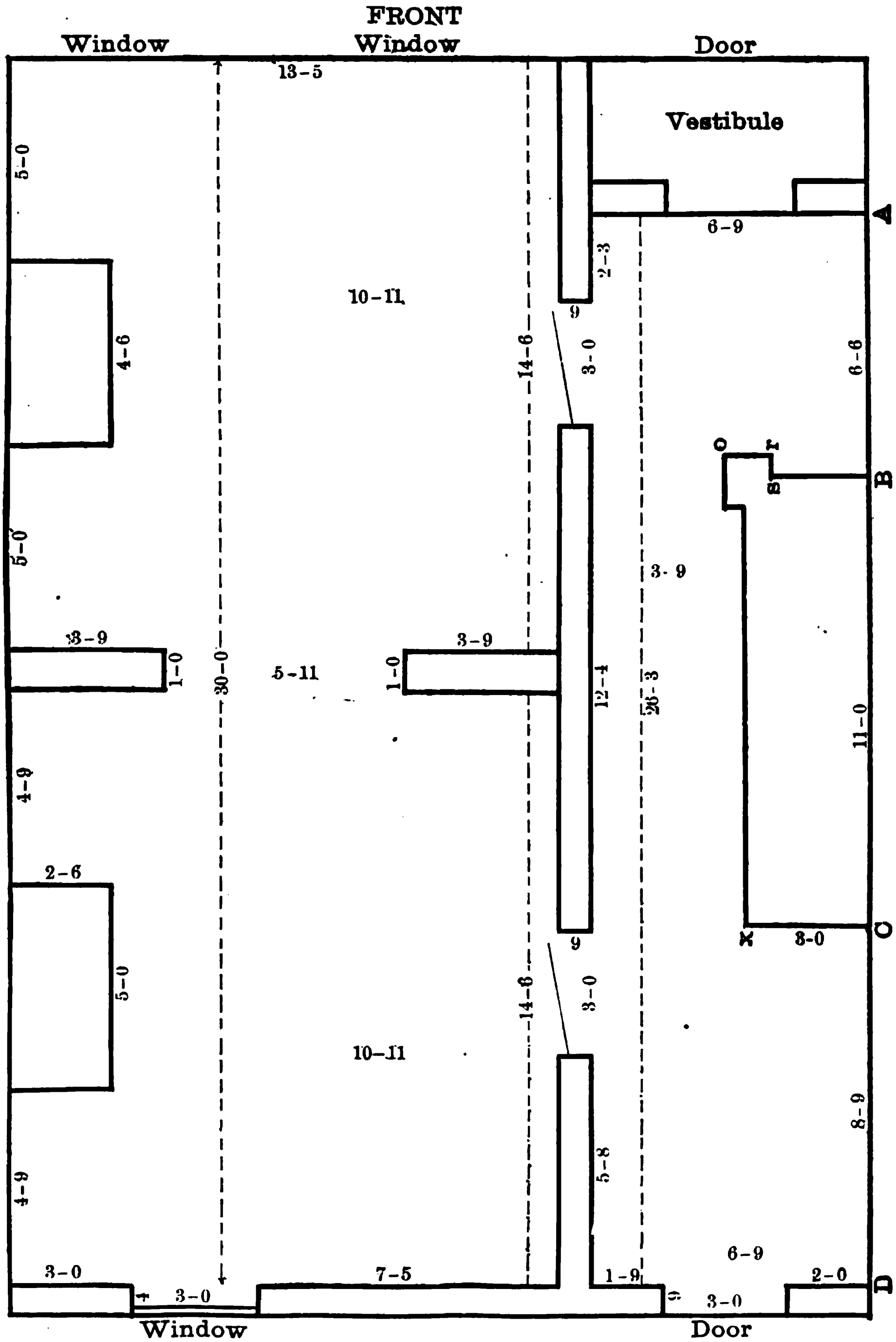

FRONT
Window
Window
Door
Vestibule
13-5
5-0
4-6
10-11
14-6
2-3
9
3-0
6-9
A
6-6
B
o
r
s
5-0
3-9
3-9
1-0
5-11
1-0
30-0
12-4
26-3
3-9
11-0
4-9
2-6
5-0
9
3-0
C
x
8-0
14-6
10-11
3-0
5-8
8-9
4-9
6-9
3-0
3-0
7-5
1-9
2-0
3-0
D
Window
Door

DIAGRAM 22.

should measure the width of the carpet, as frequently the goods measure a fraction more, and sometimes less, than twenty-seven inches, in which case it makes quite an item in large spaces, as churches, halls, etc. A room 15.11 wide may be covered with seven widths of Brussels carpet, owing to the breadth measuring a fractional part of an inch more than twenty-seven inches; and, on the other hand, seven widths may not cover a room 15.9 wide, because the breadth measures a fractional part of an inch less than twenty-seven inches. Therefore, invariably measure the width of goods before cutting the carpet.

The next question which presents itself is,—

On which side should the selvedge edge be placed, and on which end should the turn-down be made?

As to the *side*, this question is self-evident in the double parlor. (See Diagram 22, page 135.) In regard to the *end*, it would be preferable to turn under the surplus at the front end in case the carpet should cut to waste,—for this reason: The total length of the double parlor is 30.0; the back-window recess is four inches deep, making the total length into the window 30.4. Supposing the carpet cuts 31.1; then, if you turn under one inch at the front end, the widths at each side of the window in the rear parlor will necessarily be cut into 1.0; whereas, if you start to make the turn-down at the rear end, the carpet will be cut into only five inches instead of 1.0. However, should there be other considerations, such as using remnants in

recess, cross-joining, or saving of carpet, let these points have precedence. In most instances, when the seams or widths run parallel with the fire-place, the selvedge is placed along the straight side of the room, and the surplus is turned down on the fire-place side; and if the widths run towards the fire-place, the surplus over-widths should be turned under on the opposite side of the principal entrance. In Diagrams 13, 14, and 15 the selvedge edge should be placed along the side D C; Diagram 16 along the side B C; for the reason that the entrances to these rooms are located on these sides. The same rule should apply where border is used. If connecting rooms or halls have the same pattern, be sure and have the figure, or the stripe that the design produces, in a straight line between the rooms or spaces. Generally, the question on which side to place the selvedge, etc., will readily be determined.

Care should be taken, in locating and marking off the recess and door-pieces, especially in cases where some of the lengths have been omitted. Thus, supposing, in Diagram 1, the length of the fire-place is omitted, and only the length of each recess is given,—commence at the front end, fasten the tape-line at F, and measure off 5.6 to E; still keeping the tape-line fastened at F, mark off 15.0, the total length of the room; then, from this point (15.0), mark off the distance 5.0 to D; then will the distance between the points E and D measure 4.6.

An error that is frequently made by beginners, after having marked off the distance F E, is to commence from the other *extreme end* of the carpet and mark off the distance C D. Now, then, what will be the result? A little reflection will show that the distance between E and D will be just that much longer than the difference is between the length of the room and the full length of the carpet.

Illustration. The length of room (Diagram 1) is 15.0; the length of the carpet, we will say, cuts nine inches longer, making the total length 15 feet 9 inches. Then, commencing from the end F, you mark off 5.6 to E; now, removing the tape-line, and placing it at the other *extreme end* of the carpet, you mark off 5.0, the length of the other recess; in this manner the distance between the two chalk-marks—that is, the distance between D and E—will measure 5.3, or *nine inches longer than the length of the fire-place.* Why? Because 5.6+5.0, the length of the two recesses, equals 10.6. Deducting this length from the total length of the carpet, which is 15.9, there remains 5.3. Hence it is evident that in placing the recesses in this manner, the recess D C will not be long enough to reach the fire-place by nine inches.

The next question which presents itself is,—

In which direction are the figures or design to point? That is, is the top or head of the pattern to point towards the windows, and especially the front windows? or should the principal consideration be to run the figures from you as you enter the door, regardless of light or windows?

Opinion is somewhat divided upon these questions, and as their settlement depends somewhat upon the

style, pattern, class of goods, and the position of doors and windows, it will be well to discuss here some of the leading points.

In arranging prominent designs, especially floral patterns, the top or bottom figure of which can be easily distinguished, *the top or head should invariably point towards the principal windows, especially in parlors and front rooms.*

In Diagrams 1, 2, 3, 4, 5, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, and 22, the top of figures should, by all means, point towards the *front*, irrespective of entrances. As will be seen by careful observation, the colors, tints, and general shading of the design is made with this intention, and produces a more harmonious effect than by running the figure in the contrary direction.

In a hall, as in Diagram 22, it is permissible to run the top of figures from you as you enter the front door; but should the hall and parlor be of the same pattern, and especially if it be a reception hall and parlor, as in Diagram 21, the top of figures *should point towards the front of house* in both hall and parlor. If the stairway is to be covered entirely, or if regular stair-carpet is used, the figure should point upward; that is, point from you as you ascend the stairs. Should the stairway be covered with Moquette, Wilton, or Velvet, it would be advisable to have the "nap" run *downwards*, because, in sweeping, the stairway is swept downwards; hence, the carpet can be better swept and cleaned with the nap, than

against it. If the pattern should run in a direction contrary to the nap, the judgment of the cutter will determine which of the two arrangements is best suited for the occasion. We would suggest, if the figure is not too decided, to lay the stairway as proposed above.

As to "*shading*" in Moquettes, Wiltons, or Velvets, the "nap" should invariably point towards the strongest light; that is, the smoothness of the goods should be in the direction of the strongest light; for if you run the "nap" in the contrary direction, and stand at the front windows, and look towards the rear end of the room, the carpet will shade *light;* if you walk to the rear end, and look towards the front windows, the carpet will shade *dark*. By running the "nap" towards the front windows, however, you will have a *uniform shade* in viewing it, either from the front or rear of the room. But sometimes this conflicts with the pointing of the figures, as the various manufactures differ,—some arranging the top or head of figures to run with the smoothness of the nap, and others arranging them to run in a contrary direction. The cutter must exercise his judgment as to which of the two arrangements is the better. The carpet that has the nap running in direction with the top or head of figures, can be applied with satisfaction in the greatest number of instances. With some designs, however, it is immaterial which way the pattern runs; but due caution should be exercised before deciding.

The next question to consider is

"BORDERS."

How should the border be arranged?

This question is easy of solution in ordinary rooms; but it requires reflection and carefulness in many instances. Some rooms will look well by arranging the border in a certain manner; but take a room of the same shape and smaller dimensions, arrange the border in the same manner, and the effect will be marred very materially. But, again, take Diagram 2: you can arrange the border in this room in six different ways. Therefore, as it sometimes depends upon the size and shape of rooms and the width of border, it will be well to consider in what manner some of the following diagrams may be bordered.

Suppose we take for our illustration Diagram 2. As before stated, the border can be arranged in this room in six different ways, as will be seen by inspecting Diagram 23, page 143, Figures 1, 2, 3, 4, 5, and 6, which are proportional drawings of Diagram 2.

In bordering* the room as shown in Diagram 23, Figure 1, it will be observed that the border will project beyond the fire-place in the upper recess to the extent of ten inches.

Figure 2 has four widths of carpet and border, thus making the carpet 12.9 wide, in which case there will be three inches to fill out in front of the closet, and 1.6 in the lower recess.

---

*We will apply the ⅝ border in all our illustrations, unless other widths are mentioned, as nearly all borders are ⅝.

In Figure 3 the closet is ignored; the border in this recess is made on the same line as the lower recess; or, in other words, the room is made 14.3 wide at both ends, and the surplus border at closet is turned under or cut out, as desired.

In Figure 4 the border is placed in front of the fire-place, and both recesses are furnished with carpet or filling.

In Figure 5 the border is made on the line with the closet, and is extended over the fire-place, making a return in the lower recess, as will be observed by inspecting this figure.

In Figure 6 the border follows the shape of the room and around fire-place.

Now, the question arises, Which of the six figures is the most desirable? In our estimation, Figures 1 and 2 are the most practicable, providing a hearth-rug is used in Figure 1, to conceal the abrupt ending of the border in the upper recess. In treating the border as shown in Figure 2, the carpet can be used to better advantage in case of changing for another room; or, when one end is worn more than the other, it can be more readily changed when made in this manner; and it will look as well, if not better than any of the other figures, especially Figures 5 or 6.

If the dimensions are favorable for an even number of widths, or very nearly so, as in this case, we would advise to border the room as shown in Figure 2; but if the upper recess should be deep enough to prevent the border from projecting too far beyond the

Fig. 1

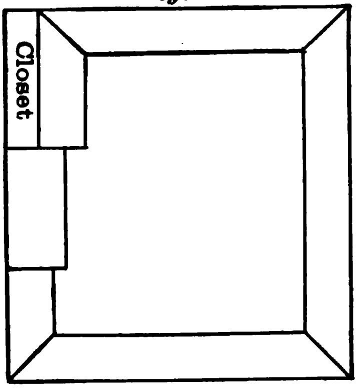


Fig. 2

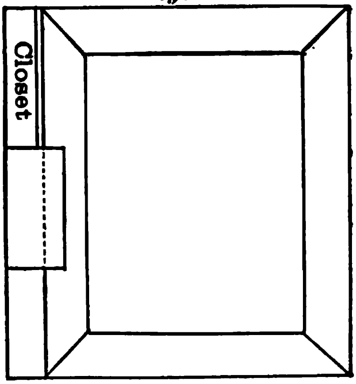


Fig. 3

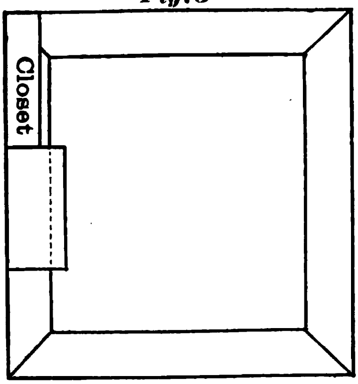


Fig. 4

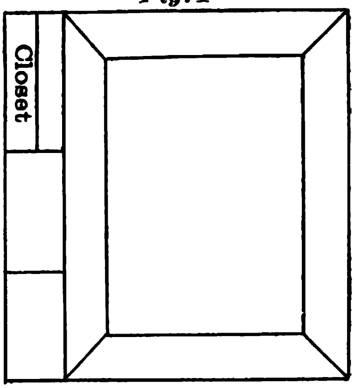


Fig. 5

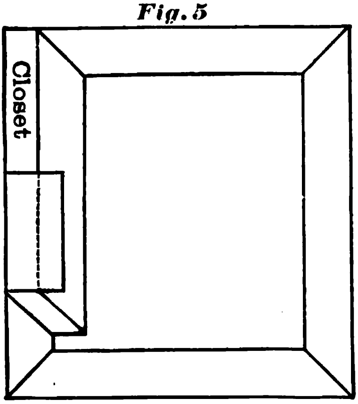


Fig. 6

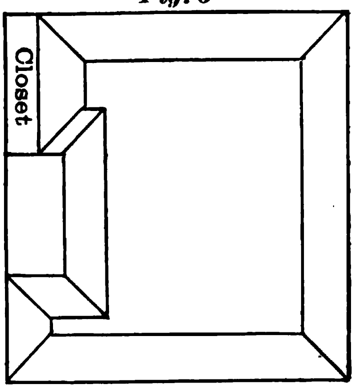


DIAGRAM 23.

edge of the fire-place, the room may be bordered as in Figure 1.

In Diagram 3, it certainly would not be displaying good taste to miter the border around the jambs at sliding-door and around the fire-place; but terminate the border at each end of the fire-place, run it straight across the opening of the sliding-doors, and fill the window and door recesses with the same carpet as used inside the border, or with suitable "filling" to match the outside edge of border.

Diagram 11 is a double parlor. Generally, in rooms of this shape, the border follows the outline of the rooms, excepting around fire-places and folding-door jambs. In some cases the border follows around the latter; but this does not produce a good effect, especially if the opening should not be over 6.0 or 7.0, as it makes the space between the borders too narrow.

Another way to border these rooms, is to make each room separate; that is, to run the border straight across the double door in each room. The advantage of this is, that each carpet can be better handled and cleaned when taken up, and one carpet may be removed without disturbing another. This is a matter of no little consequence with some customers, and of decided convenience when they can not well spare both rooms at the same time.

The border may also, in some cases, run straight across the opening of the bay-window, especially if portieres are used, thus making the room a square,

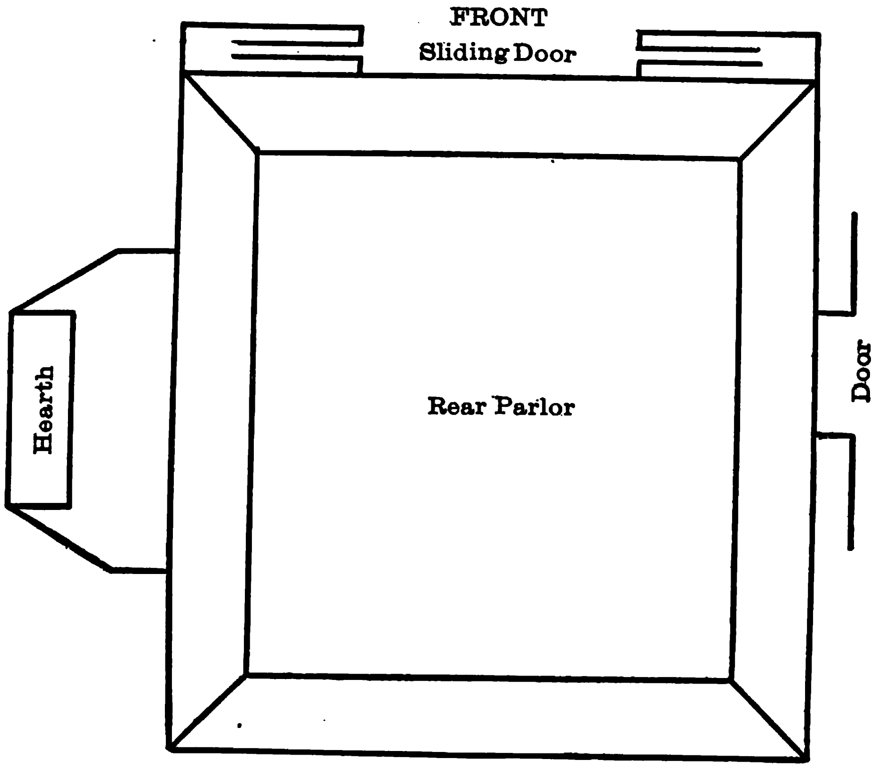


DIAGRAM 24.

with the exception of fire-places. The writer has, in many instances, treated bay-windows in this manner with entirely satisfactory results; and as to the question of good taste, there is no doubt that a room with a shallow or small bay-window, or other small recesses, will be more pleasing to the eye, and the carpet show to a better advantage, by avoiding, as much as possible, a border around projections, jambs, recesses, and fire-places, thereby reducing the number of miters, and forming the border as near a square or rectangle as can consistently be done.

Diagram 24 shows the effect of running the border straight across the bay-window, and filling the recess with the same kind of carpet used inside of the border. By this method the carpet can also be used to better advantage in changing for other rooms; and should the carpet receive more wear at one end of the room than at the other, it can be changed, with little alteration, by turning the carpet around and placing it end for end.

Diagram 25, Figures 1, 2, 3, and 4, are similar in shape to Diagram 11. These figures show the various ways in which this room can be bordered. Figures 1 and 2 in our estimate show the most desirable modes of arranging the border.

In rooms where the fire-place is in one of the corners, as in Diagram 8, the border should end in each corner of the fire-place. In fact, cut off the border at each end of all fire-places, and do not miter around them unless specified by the customer. Should the

FRONT

Fig. 1

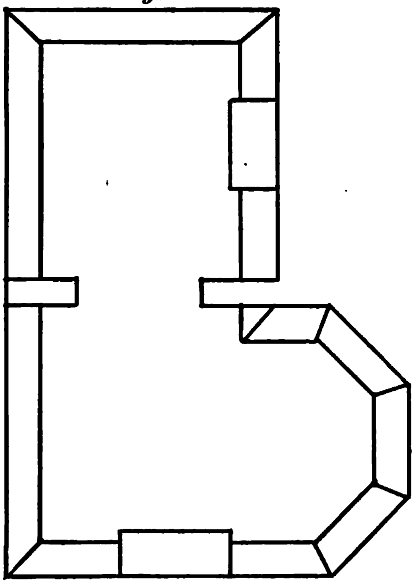


Fig. 2

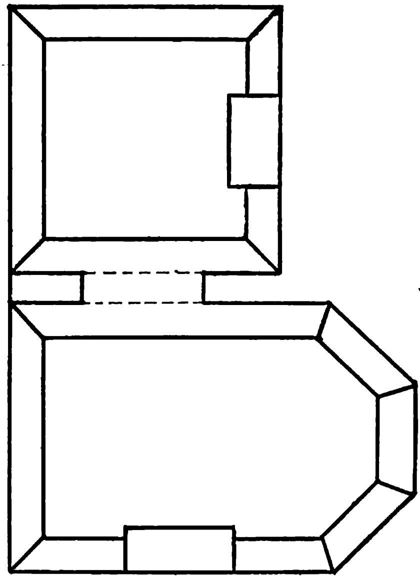


Fig. 3

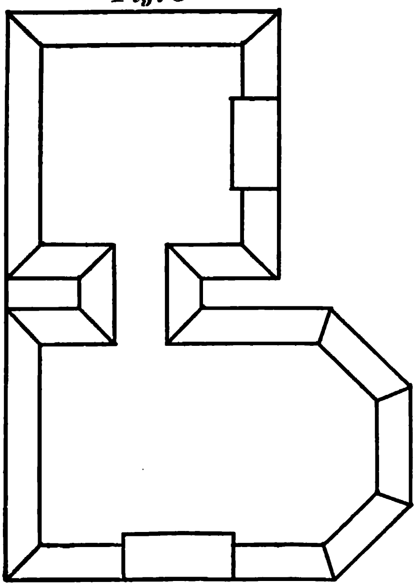
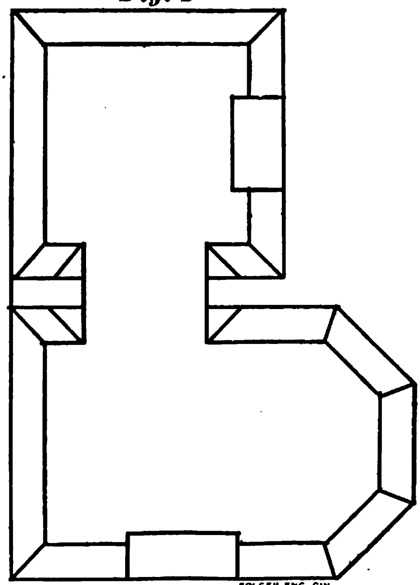


Fig. 4



FOLGER ENG. CIN.

DIAGRAM 25.

depth of fire-place be less than the width of border—say about four inches, thus making the depth about 1.6½—run the border straight across, as if there were no fire-place, unless the question of economy arises.

In Diagrams 9 and 10 the border follows the outline of the rooms, except around fire-place; there is no alternative, as can be seen by inspecting these diagrams.

In Diagram 12 it produces a very good effect to have the border follow the shape of the circular window; that is, in cases where the space will allow it. In this diagram the opening will permit doing so; but in Diagram 16, if you conform the border to the shape of the angles at D E and G H, and then around the circle, it will mar the effect very materially, as there will be too much border crowded into a small space; and it will cause the opening at H D and G E to appear too long and narrow, and spoil the symmetry of the window. The effect of this can be shown by marking the room on the floor, and describing the border around it.

Then, the question arises, In what manner would you border the room?

In this room, Diagram 16, we would run the border straight across the opening of the bay-window, follow the shape of the inside of the room proper, and let the border end in each corner of the fire-place. Make the circular window separate, and with the same border describe the *circle complete.* If necessary, the width of border can be somewhat

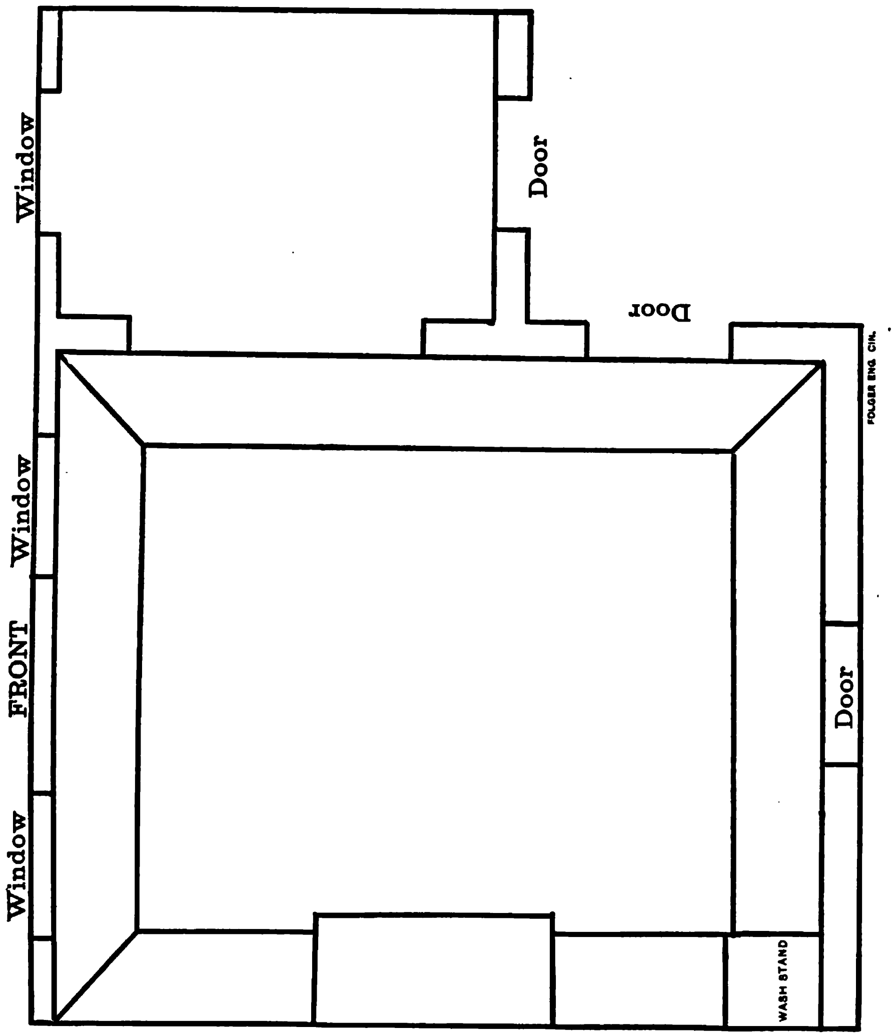

Window
Door
Door
Window
FRONT
Window
Door
WASH STAND
FOLGER ENG. CIN.

DIAGRAM 26.

reduced by cutting it down and making it 9, 12, 15, or 18 inches wide, providing the design will permit it. By making the circle complete, it will extend somewhat into the square G H D E, and the remaining space can be filled with the same carpet or suitable filling, as desired. There is no doubt that, by making the carpet for the circle window in the above manner, it will produce a better effect than by letting the border follow the outline of the room, as this would impair the symmetry of the circle. It is generally conceded that circular figures and objects are more pleasing to the eye than square or angular ones.

Some cutters think it good taste to let the border follow around small projections, jambs, and recesses. Thus, in Diagram 26, page 149, it certainly would not be displaying good taste to let the border follow around the jambs at the opening of the alcove and the small projection in the corner at wash-stand. It would look far better to let the border run straight across the opening separating the large and small room, and finishing at wash-stand, as shown in this diagram. The small room or alcove may be covered without border, as in rooms of this shape, especially if it is a front bedroom. The bed is generally placed in the alcove, and should border be desired for this room, make it separate from the large room, and use suitable filling, or the same carpet, between the borders at the opening.

The border in Diagrams 13 and 14 should follow the outline of the rooms.

Diagram 15. It would be a difficult matter to let

the border follow the outline of this room, as it would be impossible to miter the border at the points E and L, for the reason that the opening between these points is too contracted, and the borders would overlap each other. The alternative, then, is to run the border straight across the opening of the window, and fill the octagonal bay with the plain carpet, or reduce the border, as suggested on page 148, Diagram 16.

Diagram 19. The border in this room will show to better advantage by following the outline of the room. At the small curve O S the border should be made square; that is, a right-angled miter should be made by producing the straight lines, A S and G O, to a point of intersection, and fill the small space behind the border with some suitable filling. The border should not follow around the jamb 1.0 x 2.6, but should pass from F to the fire-place, and be cut out or turned under at this jamb.

Diagrams 17 and 20. These rooms will produce a very pleasing effect, and will show to better advantage with a border. Of course, the border should conform to the outlines of the rooms, except at the fire-places.

In Diagram 20 the circle should be made continuous from A to H, by drawing the curve through the opening between the points L and I; for if you run the border in a straight line from L to I, it will destroy the symmetrical effect of the circle.

In bordering around circles, care should be taken to make the various joints or seams equidistant; and

if the design of the border has a very prominent figure, have the same figure occur in alternate pieces, thereby producing a very attractive appearance.

Diagram 32 will show how the various joints or miters should be made for circles.

Diagram 21 is a reception hall and parlor. The reception hall would probably look just as well without a border, owing to the irregular shape. If border is to be used, begin at the point **o**, from **o** to **x**; then proceed in a straight line across the front end of the hall and the 11.5½ side; then across the rear end, with no border around the stair-case, as it will make the space between the borders too narrow, giving the appearance of overcrowding the hall with border. The octagonal window may be filled with the plain carpet, or a narrow border may be used, as suggested in remarks on Diagrams 15 and 16, pages 150, 151.

Should the same pattern be selected for the parlor and reception hall, and if border is to be used for both spaces, the parlor and hall should be treated separately, by letting the border run straight across the double door in each room. Do not terminate the border, as is sometimes done in the hall and parlor, against the folding-door jamb, as this produces an effect that does not conform to the outline of the rooms. The space between the borders at the double doors should be filled with suitable filling or with the same pattern as carpet.

Should different patterns be selected for the hall and parlor, and if the parlor is to be bordered and the

hall without border, we would suggest to let the double-door recess of the hall carpet meet the border in the parlor. In some cases this space is divided equally with the hall and parlor carpet, so as not to show the hall carpet in the parlor when the doors are closed. This is permissible when the doors are to remain closed most of the time, or when there is a rod dividing the sliding doors; but should the doors be kept open, which is generally the case, and there is no rod for the sliding doors, it would be advisable to have the hall carpet meet the border in the parlor as suggested above, as this gives unquestionably the best finish, and does away with the extra seam in the center of the door. If a nine-inch border is adopted for the reception hall, it would be very proper to let the border follow the shape of the hall; and no doubt this would present an attractive and pleasing appearance.

We have considered, in all our illustrations, the $\frac{5}{8}$ border, showing in what manner the various diagrams may be bordered, and giving our reasons therefor; but it should be understood that if a narrower border, as 9, 13, or 18 inches, is to be used, the same results as to appearance and good taste will not follow. In some of the rooms, as Diagrams 11, 15, and 16, it would probably look better to let the narrower border follow the outlines of the various rooms.

In arranging the border, attention should be given to match the corners, especially interior corners at the opening of the bay-window, as in Diagrams 12, 13, 14,

and 30, even if it be necessary to waste material in doing so.

If the border has a decided figure, this figure should be placed in the center of the side A B, B C, and C D in the bay-window, as in Diagram 30.

If a carpet is to be made rug-shaped, and if the corners are to be matched uniformly—that is, with the same figure at each of the four corners—the size of the rug must be made subject to the design of the border. Of course, the style and neatness of the figure formed at the corners depends upon the design of the border, and at an expense of material.

If borders are used for such rooms as Diagrams 17, 21, and 30, and rooms of similar construction, the carpet should be made with the center width, or seam, as the case may be, in the center of the room, especially if for Wilton, Axminster, or Moquette of conspicuous design. Thus, in Diagram 30, by using a $\frac{5}{8}$ border, five widths of $\frac{3}{4}$ carpet will be too wide by six inches. Now, instead of cutting off or turning under this surplus on one side only, it should be cut off or turned under equally on both sides, thus making it uniform and centering the bay-window; whereas, if it turn under on one side only, it will make the bay-window appear "lop-sided." Should the bay-window not be in the middle of the room, it should nevertheless be centered. This applies only to border carpet, and when the question of good taste and appearance is the paramount object.

The manner in which the border should be ar-

ranged will readily be suggested in the majority of cases; but there are rooms and halls that require more deliberation, and where the cutter should not act hastily in cutting the carpet, to the possible disregard of good taste and a pleasing effect.

The next and last point, "In what manner to cut the carpet as economically as possible, to admit of good results without unnecessary piecing and patching," can only be mastered by close observation, practice, due amount of caution, and diligent attention to business.

For beginners and those with limited experience, before cutting the carpet we would insist upon marking out on the floor the more difficult rooms, as Diagrams 11, 12, 13, 14, 15, etc. By doing this, it can be seen at a glance which width, and how many, will require to be long or short, as the case may be, thereby reducing to a great extent the liability of making mistakes, in many cases avoiding unnecessary piecing and a loss of goods, and insuring greater accuracy in cutting. This plan will also aid a person in acquiring a knowledge of the art of measuring and cutting in far less time than those who take the measurement of rooms, halls, etc., that are of such shape as Diagrams 6 and 7, in the following manner, namely: They will mark off, on the floor to be measured, the width of goods—that is, where each seam will come—and give the various lengths of each width required; then the carpet is cut according to the different lengths thus given.

This slipshod system of measurement and cutting should at all times be avoided.

After the carpet is cut, invariably place the size of the different lengths on the diagram, so that, should there be any dispute as to the number of yards, you will be prepared to show the customer at once where the different lengths are located, and how much they are cut over in order to match the figures or pattern. Impress his mind with the fact that you keep, for just such emergencies, a record of all carpets that are cut. If no such record is kept, it will be difficult to prove that the number of yards you have charged is correct, thus giving the customer good grounds for disputing your statement.

The question often arises, when border is used, whether to cut off or to turn under the surplus carpet. This depends somewhat upon the nature of the goods. If for Tapestry or Body Brussels, in most cases the surplus is turned under; but care should be taken in sewing and pressing the heavy seams. If for pile fabrics, as Wiltons, Moquettes, and Velvets, and when first-class workmanship is the paramount object regardless of any future change or alteration, we would advise cutting off all the surplus carpet on the ends and sides, unless otherwise requested, and sewing the border on the raw edges, as this gives unquestionably the best finish. In cases where raw edges are to be used, make sufficient allowance for plucking and raveling, as the raw edge has to be hemmed down to make a good seam.

As to the manner of sewing the various kinds of carpets, Tapestries, Body Brussels, Wiltons, Axminsters, and Velvets are in most cases sewed "over and over." Moquettes, owing to the deep selvedge, should be sewed "in and out." To make a neat and flat seam, cut or raw edges should be raveled or plucked, and hemmed down. In cases where the surplus length or width is turned under, and when a border is joined to this seam, it should be sewed "in and out." It is best to sew all seams that are not selvedged, "in and out," except in cases where the raw edges have been properly raveled, or plucked and hemmed—the seam can then be sewed "over and over," if desirable. Use what is generally known as "ball stitch" for ingrains that have smooth selvedge; and when the selvedge is very coarse and irregular, sew "over and over." In order to make a flat and strong seam, the stitches should be taken close together, and each stitch well drawn; and do not take one stitch deeper than another, but sew uniformly and close to the edge, thus making a straight and smooth seam. Sewing carpets by machine is now done extensively by most of the leading carpet-houses throughout the country. The machines have been so perfected within the last few years, that the work performed by them gives entire satisfaction.

The practicability of showing, in the various diagrams, the number of yards that the different rooms require, indicating when and where to cut off the surplus width and utilizing the same in other portions of

the room, and when to use full widths or parts of widths, depends upon various conditions; namely, the length of pattern, class of goods, extent of economy desired, nature or character of the room, or whether quantity of goods is limited, etc. It would be impossible to give an exact estimate without first knowing all the above circumstances, and no particular advantage would be derived by giving the yards approximately.

We would, however, suggest that, if first-class workmanship should be desired, all piecing, cross-joining and mismatching of half-widths should be avoided. Never reverse cut-pile fabrics, as Moquettes, Wiltons, and Velvets, as they will invariably "shade." Patterns that have the same figure in the center of width as is on the selvedge, can be cut in the center, and the entire one-half width may be matched by placing the raw edge along the side of the selvedge edge. In cutting the one-half width, allow a couple of threads inside the center, as the cut edge must be raveled to make a strong seam, and be careful to make this allowance on the proper side.

In cutting the different lengths of border for a room, an allowance of one inch more than the given length will suffice if the border is cut straight across. Thus, in Diagram 3, allow one inch more than the given lengths on the one side and two ends, but about four inches for each recess, so as to allow for a turn-down at each end of fire-place.

If the corners are to be cut out, and the room to

be covered entirely, then allow about four inches more for each end and side than the given length.

If corners are to be "butted," which is generally done with Moquettes, Wilton, and Velvets, an allowance of about two and one-half inches will suffice over the given length for plucking.

Carpets that are made "rug-shaped" should invariably have the corners butted. They should be thoroughly pressed and sized, and all corners and raw edges properly bound. Should the border be wrinkled, stretch it before cutting off the given sides and ends.

After the carpet is made and stretched on the floor ready for shrinking and pressing, be careful not to wet the end borders too much; otherwise the corners will be drawn out of square,—for the reason that the border will not shrink as much in the *width* as it will in the *length;* and as the *end borders* are at right angles with the *width* of the carpet, they will shrink more, if they are watered, in the same proportion as the remainder of carpet, and the result will be drawn corners.

If an ingrain carpet cuts longer than the room, only one end should be hemmed, and the other end overcasted; for if both ends are hemmed, and there is a surplus of three inches or more to be turned under at either end, this hem will produce a ridge across the whole width of the room.

For rooms that are to be bordered, the carpet

should be cut and sewed together before fitting the border—of course making the necessary deduction, when cutting the carpet, for the border on ends and sides. Mark out the room accurately, as suggested in the preceding pages, and draw the various chalk-lines where the miters occur, by bisecting the angles, as shown in Problem 9; then cut and place the border in the various positions required. Next, tack the border close to the chalk-lines. It is not necessary to use a stretcher in ordinary-sized rooms, unless the border should be very much wrinkled. Tacking one end of the border, and giving it a slight kick with your heel at the other end, is all that is required. After the border is tacked, and the corners are properly mitered, place the carpet inside, and tack and fit it close to the border. Of course it will be necessary to apply the "stretcher" in this case, in order to stretch the carpet smooth, as there is always more or less puckering. Should there be any puckering which can not be remedied with the stretcher, wet the carpet on the wrong side, and iron with a hot iron. With this treatment the puckering will be casily overcome.

In rooms which are right-angled, as Diagrams 1 and 2, the border may be cut and sewed on the one side and one end when the carpet is joined together. After the carpet is sewed, with the one side and end border attached, fit and tack it to the remaining side and end border. After the carpet is properly fitted—

and it should be adjusted to the chalk-lines as if it were to remain on the floor permanently—and before taking it up, draw a chalk-mark across the border and carpet at intervals of about two feet, this being a guide to the sewer, answering the same purpose as tacking. Now take up the carpet, and carefully baste the various miters, and turn down. After the carpet and border are sewed together, all the seams and miters should be thoroughly pressed. Before folding up the carpet, examine it with care, and see that there are no defects, and, before sending away, have it well swept of any litter of the work-room that may have accumulated.

The carpet is now finished, and ready to pass into the hands of the carpet-layer; and as upon him depends, to a certain degree, the successful completion of the work, it would not be amiss to offer the following few notes and suggestions:

The carpet-layer, upon entering the house and stating his mission, should be polite, and answer all questions courteously. When furniture is to be moved, he must not shove and handle it in a reckless manner. Should there be an error caused by the measurer, cutter, or otherwise, which can be easily remedied by a little skillful management, he should rectify it at once, and not call the customer's attention to it, and comment upon it, saying it ought to have been done thus or so.

If the customer should find fault as to the quality,

sprouting, shading, number of yards, or similar matters, over which the carpet-layer has no control, he should not enter into any controversy on the subject, and give the customer an opportunity to say, in complaining to his employer, that the carpet-layer said so and so, and that he can verify any objections made. By allowing his tongue to wag too freely under such circumstances, the workman can create a great deal of mischief. If any complaints are made in respect to defects which he can not rectify at the moment, he should politely inform the customer that the store is the proper place to make all complaints. After the carpet is laid, he should arrange the furniture as nearly as possible in the same position he found it. He should pick up all the cuttings and scraps made in his work, and not leave them strewn about the room, nor leave tacks scattered on mantel-piece, window-sills, or furniture. When done, he should call the proper party, and ask if "Mister or Madam will please inspect the work, and see if everything is satisfactory." By being pleasant and accommodating, and doing his work neatly and intelligently, the carpet-layer will gain the confidence and good-will of both customer and employer; and when needing a layer at another time, those in whose houses he has been employed will be very likely to ask for his services in preference to those of another; and his employer will send him wherever demanded, fully satisfied that he will meet every requirement.

STAIRWAYS.

Showing how to measure and treat coverings.

Diagrams 27 and 28, Figures 1 to 6, are variously shaped stairways. The dotted lines show the required measurements. Of course it is understood that the tape-line should follow the shape of the stairway, treads and risers included.

An allowance of about one-half yard should be made in addition to the net length for stairways from 25 to 30 feet long; and for a longer stairway, say about 35 to 38 feet, and heavily "padded," add about 2.6 and 3.0 to the net length. This is to allow for shifting the carpet, as the greatest wear is at the nosing of each tread; this worn part can be shifted to the angle or intersection of the tread and riser when being relaid. In many instances the stairs are covered entirely in place of the ordinary stair-carpet. When this happens, in most cases more than one strip of the $\frac{3}{4}$ width, varying from $1\frac{1}{4}$, $1\frac{1}{2}$, to 2 full widths will be required, according to the width of the stairway.

With most patterns by using $1\frac{1}{4}$ and $1\frac{1}{2}$ widths, only part of the length will be matched, and this should be placed at the bottom of the stairway, and the mismatched piece towards the top.

In some cases halls are of such dimensions and shape, that there is more or less turned under in the width of the carpet, and there is a possibility of using this surplus over-width for the extra strip that may

be required on the stairs. The extra strip or part of width should not be placed along the side of the balustrade, but along the opposite side, where there is less wear and walking.

There are some designs of such a nature that, if this extra strip or part of width is placed on one side only, it will make the stairway look "lopsided." In this case it will be necessary to divide the extra strip equally, by placing it on either side of the full width, thus producing a uniform effect.

Should the stairway require more than 1½ width, instead of turning under or cutting off the surplus along one side only, place the seam in the center of the stairway, and cut off or turn under the surplus equally on both sides, as this will unquestionably produce the best appearance.

In Figure 1 the carpet should be made in two sections. The bottom section should extend from A to B in one continuous length, thus avoiding the extra seam across the nosing at landing marked O S, which would occur if the upper section were to be made in one length from B to D. The upper section should be made from C to D.

Figure 2 is very often made in three sections, from A to B, E to F, and a separate piece for landing. Another method is to make the lower section and landing in one continuous length from A to C, thereby avoiding the seam across the nosing at landing in O B; and the remaining widths that may be required from O to E should run in the same direction

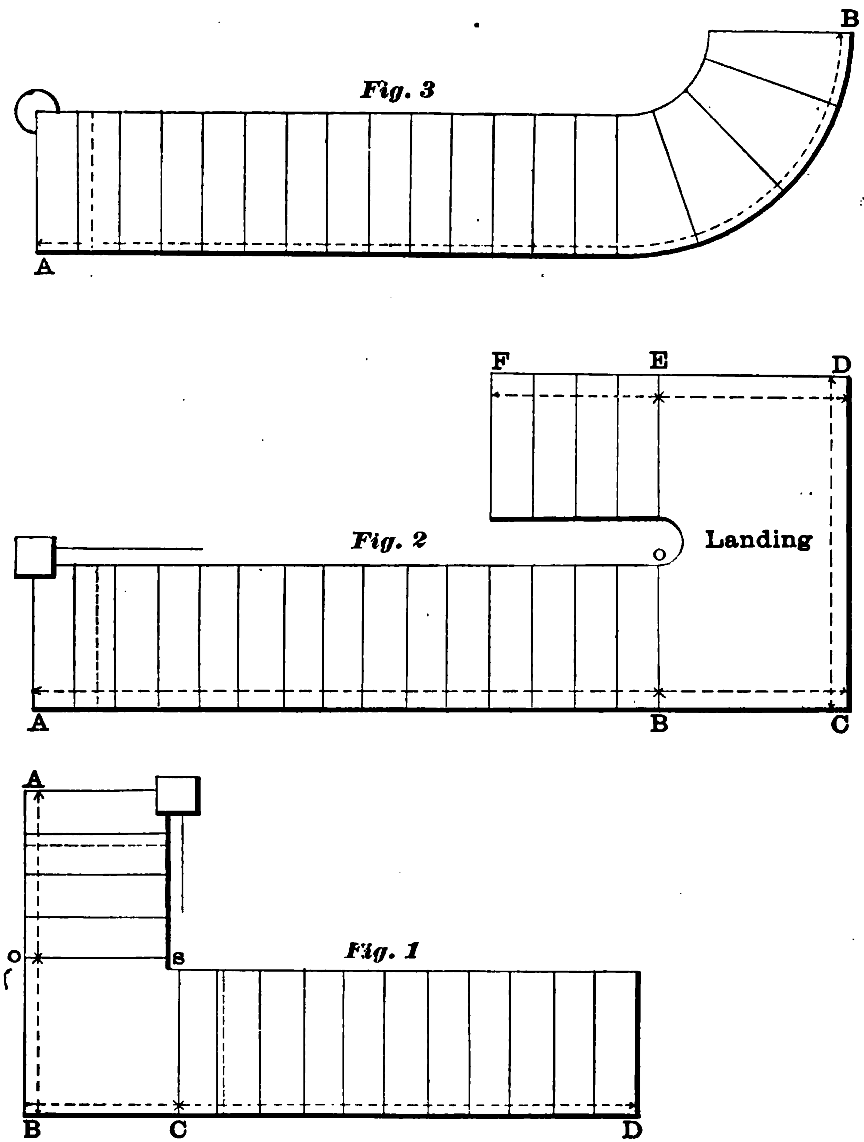


DIAGRAM 27.

as A C; that is, the short way. The upper section should be made from E to F, thus arranging the stairs in two sections.

Figure 3 is made in one continuous length from A to B. In measuring stairways of this kind, place the tape-line close along the side A B, which gives the greatest length.

Figure 4 should be made in one length from A to B; another piece from C to D; another section for the large landing, or make this landing and the section C D as suggested in Figure 2; then another section from G to H.

Figure 5 should be made in two sections,—the lower section in one continuous length from A to B, and the other from C to D.

Figure 6 is, in many cases, made in one continuous length from top to bottom; but to make a neat finish it should be made in three sections; as, from A to B; then a separate piece for the riser at B and the tread marked **o**; and another from D to E; thus avoiding the great amount of surplus turn-down which will occur on account of the angles B, C, and D, if the carpet is made in one continuous length.

Figure 7 illustrates a section of Figure 6 as it would appear when flattened out. To reproduce the figure in this manner, the measurements should be given as follows: From the bottom of the stairway at A to **m**, **m** to B, B to **o**, **o** to C, C to **e**, **e** to D, D to the top of stairway at E, **x** to **i**, **i** to **o**, **o** to **s**, **s** to **r**, **r** to **g**, and **g** to **h**.

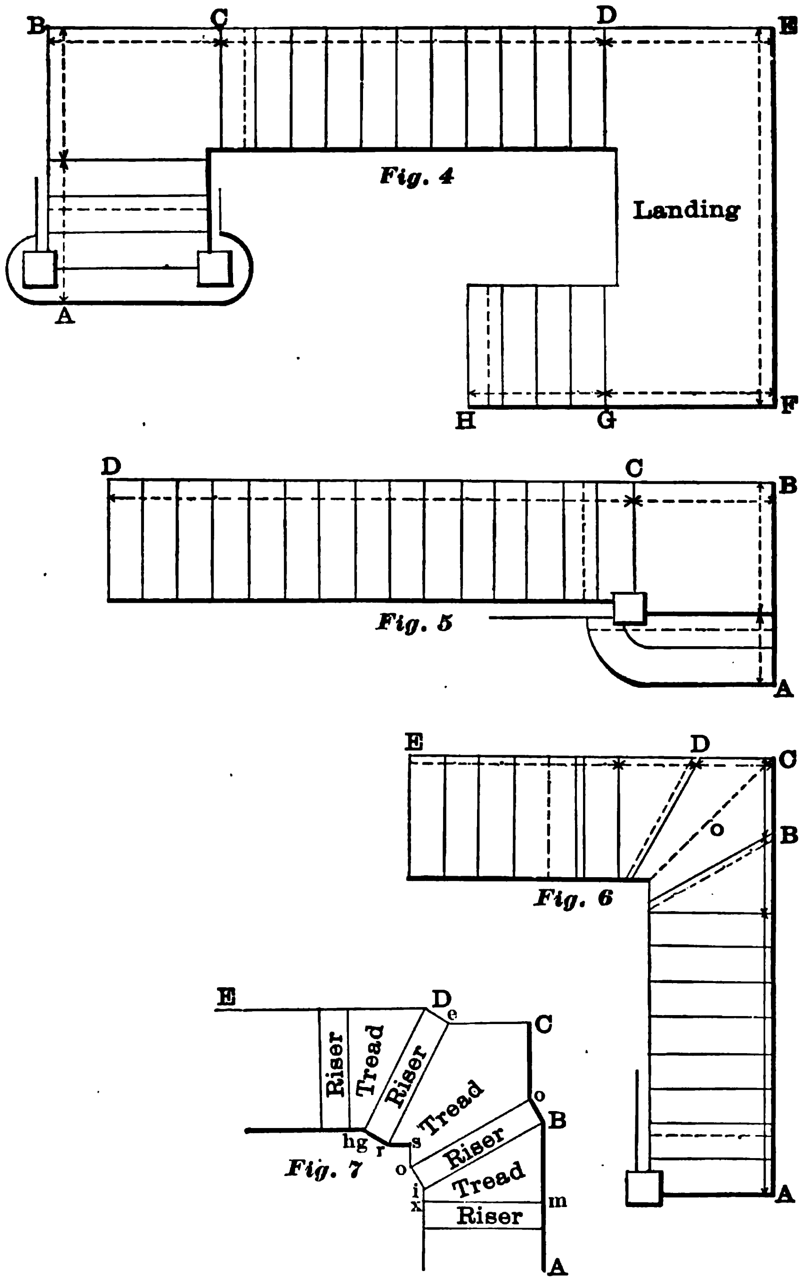

B
C
D
E
Fig. 4
Landing
A
H
G
F
D
C
B
Fig. 5
A
E
D
C
o
B
Fig. 6
A
E
D
e
C
Riser
Tread
Riser
Tread
o
B
hg
r
s
Riser
Fig. 7
o
Tread
i
x
m
Riser
A

DIAGRAM 28.

We have here considered the various stairways to be covered entirely; but if one strip of ¾ Brussels or the ordinary ¾ stair-carpet is to be used, it may be laid in one continuous length from top to bottom, without cutting; but care should be exercised in making the various miters on the landings. Should first-class workmanship be desired, and no account taken for changing in future, cut out the surplus that is caused by making the turn or angle, and sew the miters together, especially for Moquette or Wilton stair-carpet.

PRACTICAL MODEL DIAGRAMS.

To find the least number yards of $\frac{5}{8}$ border required for Diagram 29.

BEGIN with the square or straight end of border at either end of fire-place, with the outside edge to the right or left as you roll it from you. In this illustration the outside edge of border is supposed to be on the left-hand side as it is rolled out, in which case commence at A, and roll out the border to B; then,—

1. From the point B, with a right-angled triangle,* mark off the angle B^2 on the border, and cut it.

2. Place the border along the side C D, and the angle remaining on border will be in the direction C^3; then from the point D cut the angle D^4; reverse the square, and, from the point D, cut off another angle, which will be in the opposite direction of D^4, and will cause a right-angled triangle to fall out of the border marked V in marginal figure.

3. Place the border along the side B C, and the angle remaining on border will be in the direction B^2; then from the point C cut the angle C^3.

4. Place the border along the side D E, and the angle remaining on border will be in the direction D^4; then from the point E cut the angle E^5.

---

*Figure L, page 219, shows the manner in which the right-angled triangle is applied.

5. Place the border along the side F G, and the angle remaining on border will be in the direction F^6; then from the point G cut the angle G^7.

6. Place the border along the side H I, and the angle remaining on border will be in the direction H^8; then from the point I cut the angle I^9; reverse the square, and from the point I cut another angle, which will be in the opposite direction of I^9, and cause a right-angled triangle to fall out of the border marked X in marginal figure.

7. Place the border along the side E F, and the angle remaining on border will be in the direction E^5; then from the point F cut the angle F^6.

8. Place the border along the side G H, and the angle remaining on border will be in the direction G^7; then from the point H cut the angle H^8.

9. Place the border along the side I J, and the angle remaining on border will be in the direction I^9; then from the point J cut the angle J^{10}.

10. Place the border along the side K L, and the angle remaining on border will be in the direction K^{11}; then from the point L cut the angle L^{12}.

11. Place the border along the side M N, and the angle remaining on border will be in the direction M^{13}; then from the point N cut the angle N^{14}; reverse the square, and from the point N cut another angle, which will be in the opposite direction of N^{14}, and will cause a right-angled triangle to fall out of the border marked Y in the marginal figure.

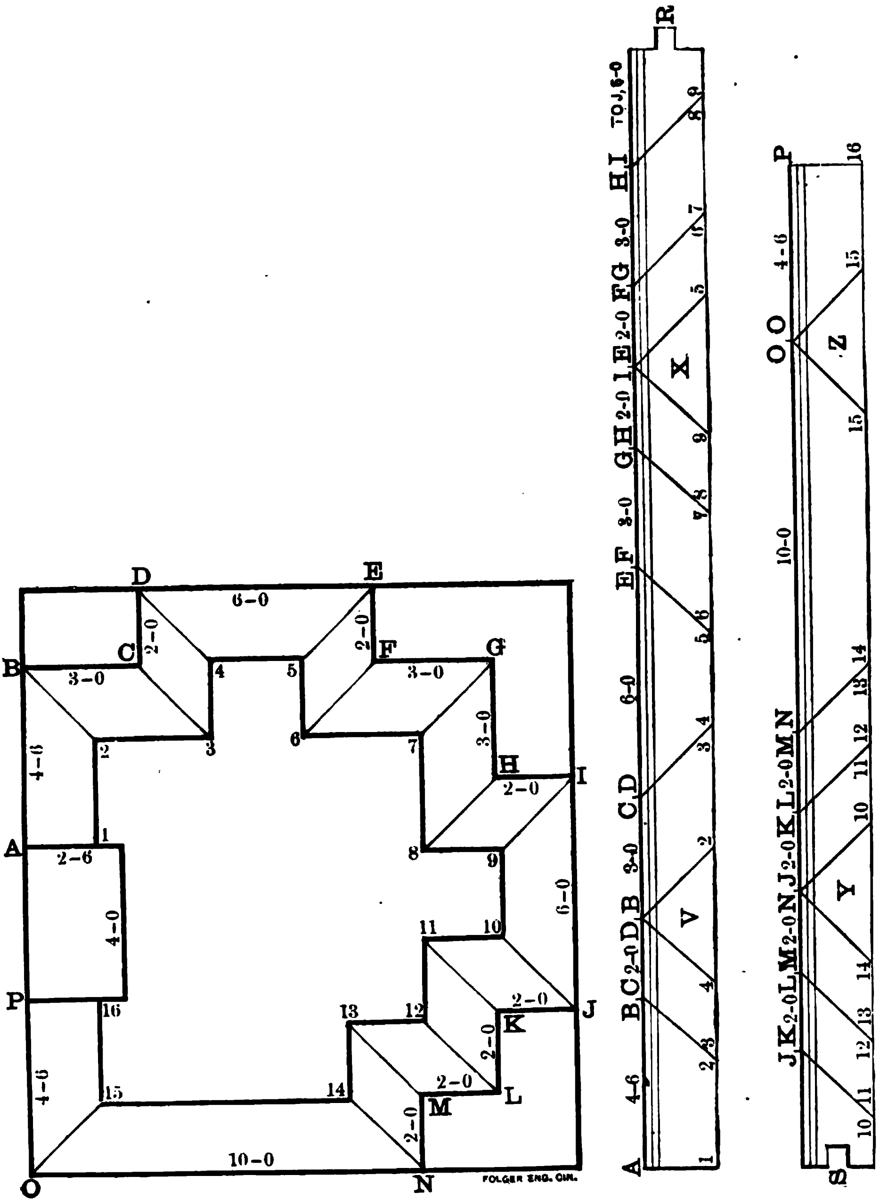


DIAGRAM 29.

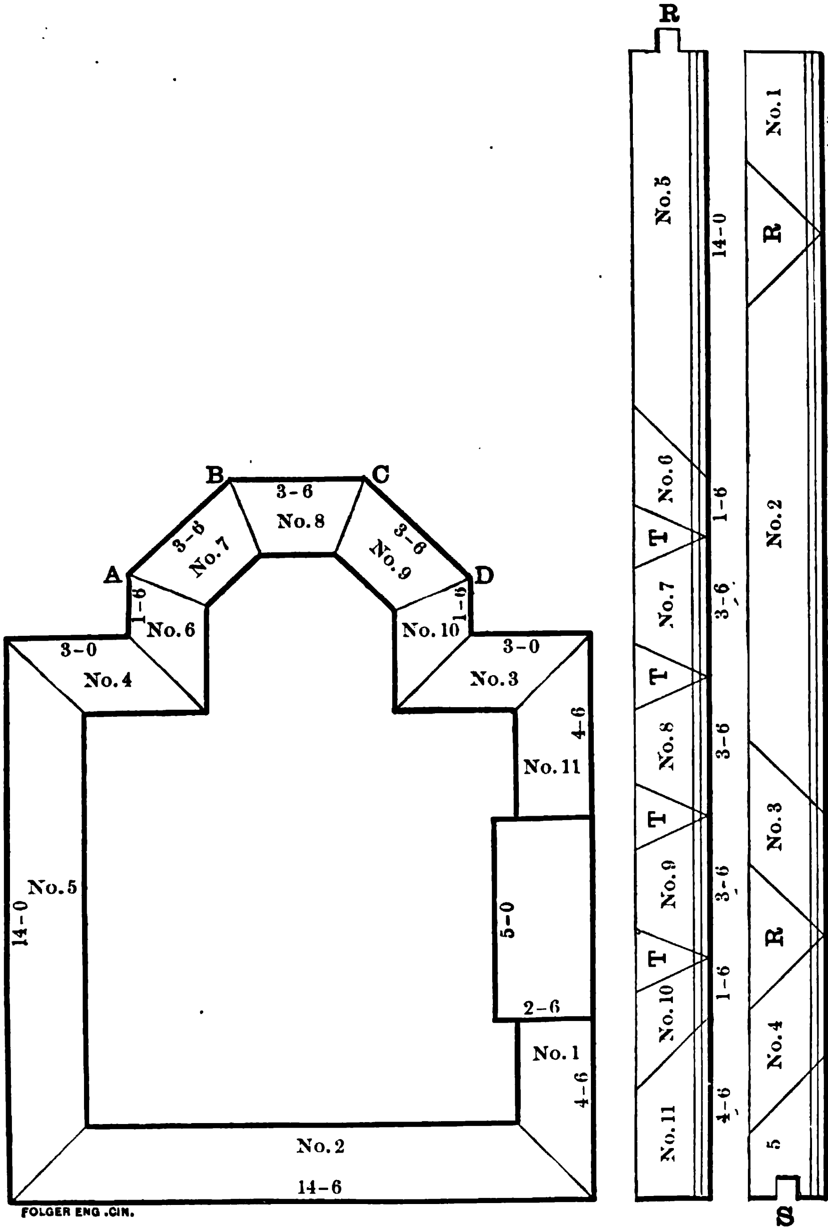
12. Place the border along the side J K, and the angle remaining on border will be in the direction J^{10}; then from the point K cut the angle K^{11}.

13. Place the border along the side L M, and the angle remaining on border will be in the direction L^{12}; then from the point M cut the angle M^{13}.

14. Place the border along the side N O, and the angle remaining on border will be in the direction N^{14}; then from the point O cut the angle O^{15}; reverse the square, and from the point O cut another angle, which will be in the opposite direction of O^{15}, and will cause a right-angled triangle to fall out of the border marked Z in the marginal figure.

15. Place the border along the side O P, and the angle remaining on border will be in the direction O^{15}; then cut the border in the point P, straight across the end of fire-place marked P^{16}, which completes the diagram.

NOTE.—By referring to the marginal figure, which represents the border in one continuous length, this will show in what manner the various angles are to be cut without loss. By cutting the border according to the above method, it will require 18 yards; but if all the corners are cut square, it will require $6\frac{1}{4}$ yards more; or $24\frac{1}{4}$ yards of the $\frac{5}{8}$ width. It will be observed that it requires the same number of yards as if the room were 15.0×14.0, which is the extreme length and width of the room, less the length of fire-place; and, in addition, there will be four triangular pieces, which



A
B
C
D
3-6
No. 8
3-6
No. 7
3-6
No. 9
1-6
No. 6
1-6
No. 10
3-0
No. 4
3-0
No. 3
4-6
No. 11
No. 5
14-0
5-0
2-6
No. 1
4-6
No. 2
14-6
FOLGER ENG. CIN.
R
No. 5
14-0
No. 6
T
1-6
No. 7
3-6
T
No. 8
3-6
T
No. 9
3-6
T
No. 10
1-6
No. 11
4-6
No. 1
4-6
R
No. 2
14-6
No. 3
3-0
R
No. 4
3-0
5
S

DIAGRAM 30.

will make a square mat 3.9 × 3.9. No account has been taken for matching and seaming in the above figures.

In cutting borders in the above manner, an allowance of about four inches for each piece should be made for seaming, and one inch will suffice if corners are to be cut square or at right angles; in which case it will require 19⅔ yards of ⅝ by cutting the border bias, and 24⅔ yards of ⅝ by cutting the border square.

NOTE.—For want of length the border in Diagrams 29 and 30 is made in two sections. The projection R is supposed to fit the opening at S, thus making the border in one continuous length. The heavy margin represents the outside edge of the border.

To find the least quantity of ⅝ border required for Diagram 30.

The solution of this figure is on the same principle as demonstrated in Diagram 29, with the exception that the angles at A, B, C, and D will be less than a right angle. The marginal figures show the various pieces, and the numbers indicate in which position each piece is to be placed in the diagram. It will be observed, by making the required calculations, that the total length of the border is 57.0 feet, which is equal to the periphery of the diagram, less the length of fire-place. There will be only two right angles, marked R, and four acute angles, marked T, resulting in cutting the border in this manner. No allowance has been made for seaming and matching of corners.

To find the various points in a bay-window, or any room or space which, owing to the finish of base-boards and moldings, are inaccessible.

Let it be required to measure a bay-window so as to be able to locate the points A, B, C, D, E, and F, which are inaccessible, caused by moldings and finish of the base-boards, and let Diagram 31, Figure 1, represent such a window.

1. Draw the straight line 1-2, Figure 2, parallel with **s** A, at a sufficient distance to clear the small projections; let **o x** represent this distance.

2. Draw the straight line 2-3, parallel with A B, and at the *same* distance as observed above; also draw the straight lines 3-4, 4-5, 5-6, 6-7, and 7-8, in the same manner.

3. After having described these various straight lines, a figure will be produced similar to the circumscribed one, but reduced, which will enable you to get all the measurements of the inscribed figure from point to point.

4. Reproduce the inscribed figure, and with the distance **o x** draw the exterior straight lines parallel with the interior straight lines, and of indefinite length, and these exterior straight lines will intersect each other in the points A, B, C, D, E, and F.

NOTE.—To many the above problem, showing how to find the various points in a bay-window or any inaccessible point, is difficult of solution; but a lack of knowledge here will, in case a border is used, usually result in a misfit. By carefully obeying our

instructions, however, the location of the various points can be accurately determined.

Very frequently rooms have a number of unequal offsets, as shown in Figure 3. It is a difficult task to measure a room of this description, and to reproduce it correctly, especially if it is not right-angled, and if only the measurements in ordinary use are given. As will be observed, neither pair of its corners is in the same straight line. By establishing the interior straight lines A B, B C, C D, and D A parallel with their respective sides, and by giving the necessary measurement, the room can be correctly reproduced. Care must be taken to draw the interior and exterior lines parallel. By a little reflection and study, the reader will see what measurements will be required, and the advantage gained by measuring rooms in this manner. True, it requires longer time to measure by the above method; but this will be more than compensated by correct fitting, especially of bordered carpets; while if the carpet should not fit correctly, owing to inefficient measurements, it will, in many instances, be necessary to rip off and resew the border, sometimes causing a loss of goods. By proper measurements all this loss of time and material is avoided.

To describe the various joints or miters in a circular window or any segment of an arc.

In Diagram 32, let Figure 1 be the given segment of a circle—it is required to draw the various joints

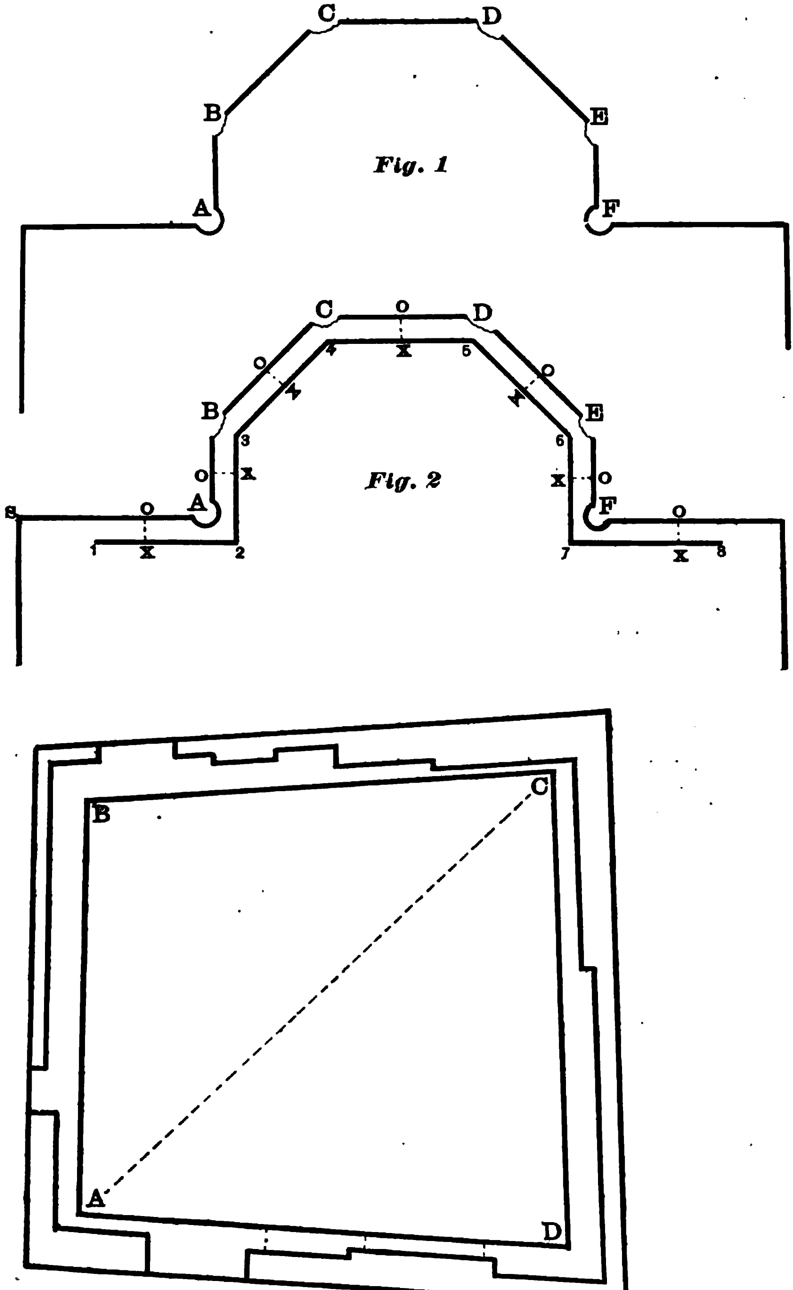


Fig. 3

FOLGER ENG. CIN.

DIAGRAM 31.

or miters for a border which is to follow the outline of the circle.

1. After having described the circumference, divide it into the required number of equal parts.

2. Then from each point of division on the outside of the circumference draw the various straight lines, each tending to the center from which the circle has been described.

3. From the point **o**, Figure 2, produce the circumference indefinitely, as at **m**.

4. From the point **o**, with a distance equal to **o e**, cut the produced circumference in the point **s**.

5. Through the points **s** and **o** draw the straight line **s n** of indefinite length.

6. Bisect the angle **C o n** (as in Problem 9) by the straight line **a b**; then will this straight line be the proper joint or miter line between the intersection of the circumference and the straight line **o C**.

A number of straight lines have now been described, which will locate the various joints or miters as required.

NOTE.—Figure 2 is drawn to a larger scale, in order to make plainer the demonstration.

The distance **C f** in this figure represents the width of the border. To many "fitters," in making the miter at the intersection of the circumference and the straight line, **C o** is difficult of solution; but by the above construction it can be readily solved.

Another method of describing the miter at the intersection **o** is, instead of drawing the joint-line from

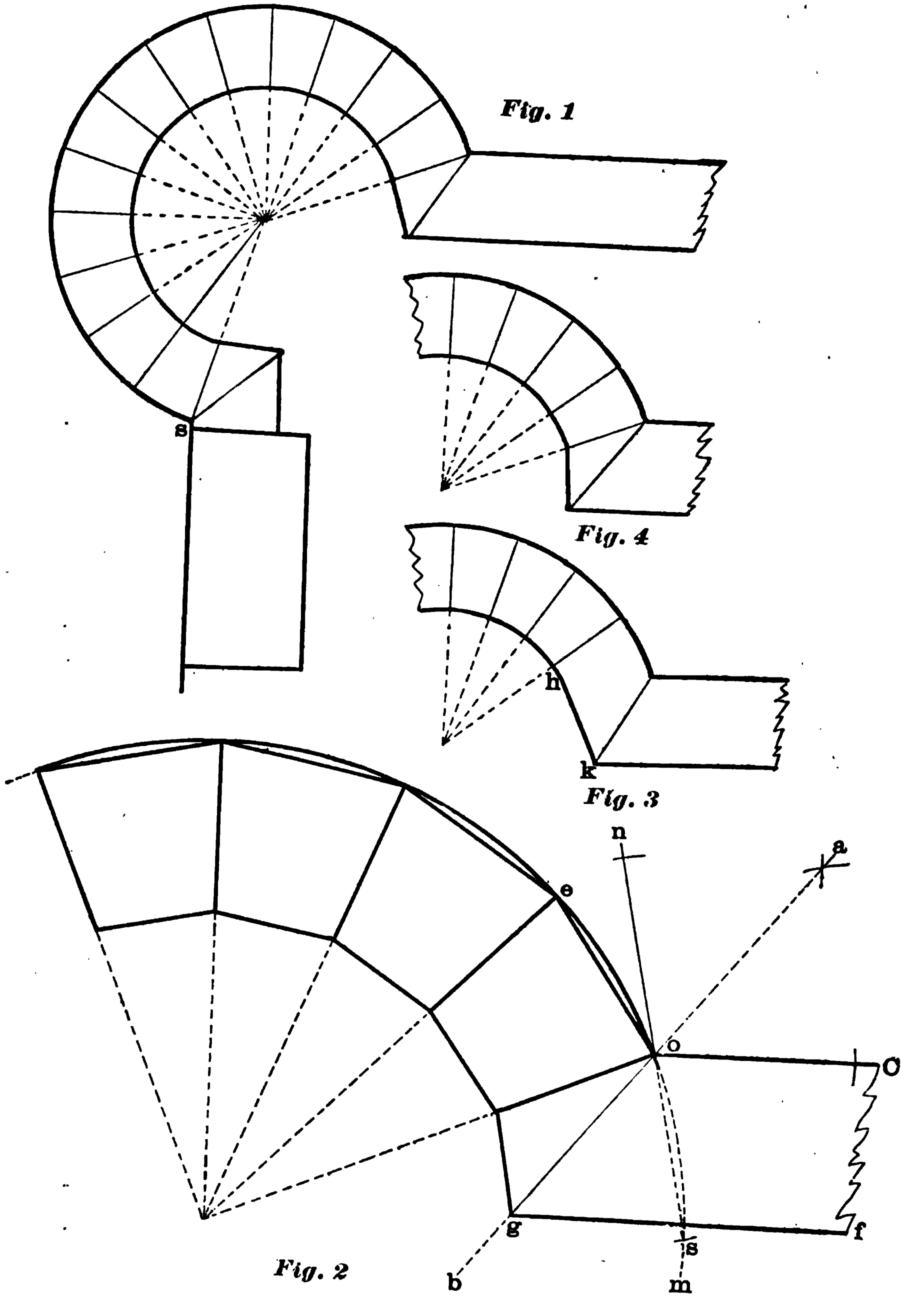


DIAGRAM 32.

the point **o** to the center of the circle, to let the borders **o e** and **o C** intersect each other in **k**, as shown in Figure 3. By treating the border in this manner, the distance from **k** to **h** (Figure 3) will be greater than between any of the other joints, thus impairing the symmetry of the border.

Figure 4 is also a section of Figure 1. Here the angle at the intersection of the circumference and the straight line is right-angled. This is not correct. The angle formed at this intersection is governed by the distance between the joints on the circumference, and should be constructed as shown in paragraphs 3, 4, 5, and 6.

To determine the distance between the joints or miters in circular windows and arches, the length of the radius describing the circle must be considered, and also the style and design of the border, as already explained in the preceding pages.

Thus, in Diagram 33, Figure 1, the joints are further apart than in Diagram 32, Figure 1, because the radius of the former is greater than that of the latter. The closer the joints or miters are together, the better will the border conform to the shape of the window. Of course, it is understood that the border will not shape as snugly to the circumference as would a piece of oil-cloth, paste-board, etc., which can be cut to conform to the circumference or arch exactly. There will always be more or less space between the straight line on the outside edge of the border and the circumference, preventing a close fit.

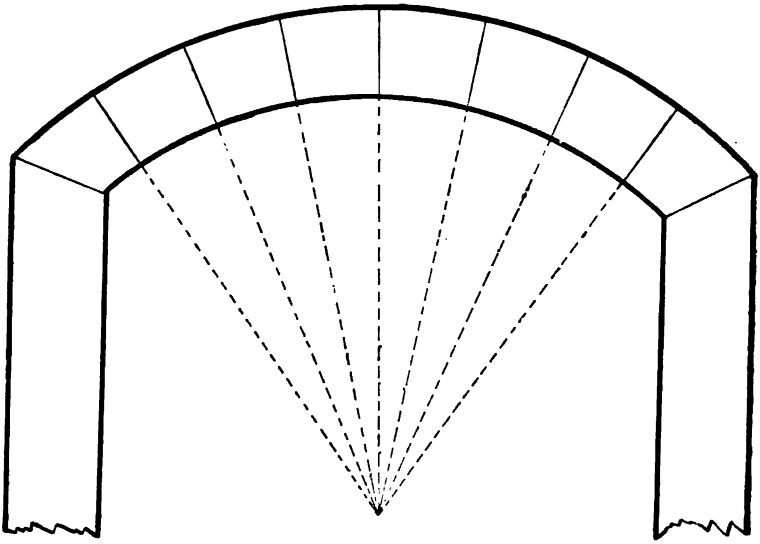


Fig. 1

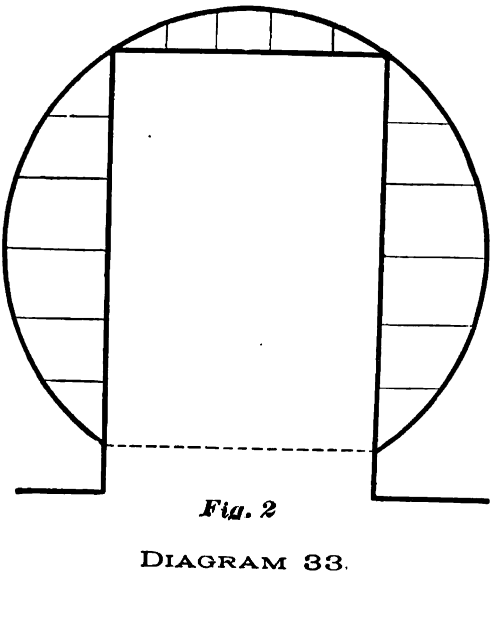


Fig. 2

DIAGRAM 33.

This deficiency must be overcome by the tact and ability of the carpet-layer.

In borders of certain designs it will be necessary to place the joints or miters some distance apart, in order to show the figure to advantage. In this case there will be considerable space between the outside edge of the border and the circumference, as in Diagram 32, Figure 2. This space should be covered with suitable filling to match the outer edge of the border.

By producing the various lines on the floor, as described in the above problem, the border can be cut and mitered to these different lines to better advantage than by any other method, thus producing a uniform succession of the various pieces of border, and creating an effect pleasing to the eye.

To measure segments of circles, ovals, ellipses, etc., by means of a number of true points, so as to be able to describe the circumference.

In Diagram 34, let A B C, Figure 1, be a part of a circumference; it is required to measure a number of true points in order to describe the circumference.

1. Draw the straight line A C, Figure 1, and divide it into any number of equal parts, say seven.

2. From each point of division get the various lengths to the circumference—as, 1 **d**, 2 **e**, 3 **f**, 4 **g**, 5 **h**, 6 **i**, and 7 **k**—and make a dot at each point in the circumference from which the measure is taken at **d**, **e**, **f**, **g**, **h**, **i**, and **k**.

3. Then from the points A or C get the different

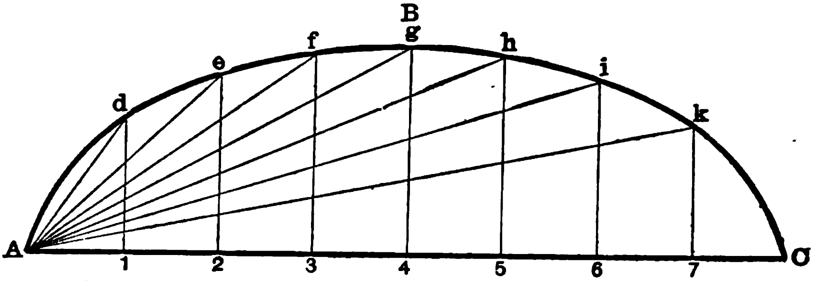


Fig. 1

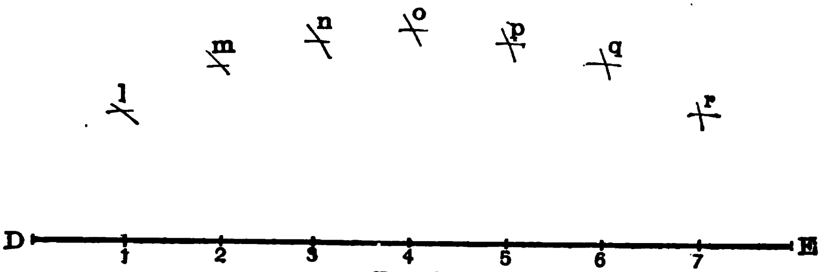


Fig. 2

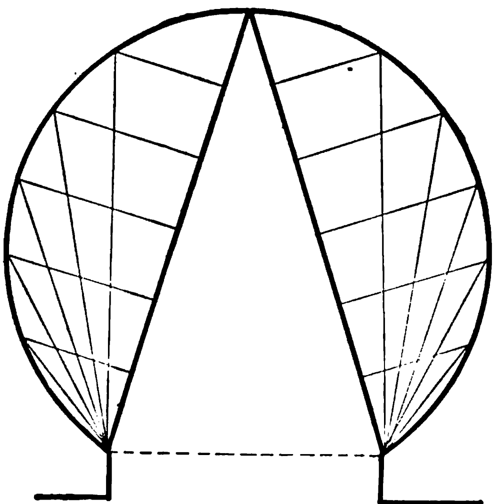


Fig. 3

DIAGRAM 34.

lengths to the various points on the circumference, as A d, A e, A f, A g, A h, A i, and A k.

The circumference has now a number of true points through which the curve can be traced, as will be seen in the following problem:

TO DESCRIBE THE CIRCUMFERENCE.

1. Draw the straight line D E, Figure 2, equal to A B, Figure 1, and on D E locate the points 1, 2, 3, 4, 5, 6, and 7, equal to the given distance, as on A C.

2. From the points 1, 2, 3, etc., on D E as centers, and with a radius equal to 1 d, 2 e, 3 f, 4 g, 5 h, 6 i, and 7 k, describe arcs at l, m, n, o, p, q, and r.

3. From the point D as a center, and with a radius equal to A d, A e, A f, A g, A h, A i, and A k, describe arcs intersecting the former in the points l, m, n, o, p, q, and r. A number of true points have now been established, and through these draw the curve by means of proper sweep. The curve thus drawn will be an exact reproduction of Figure 1.

After the points are properly located, drive a tack in each point of intersection, just enough to make it firm, and, with a flexible rod or stick eight to ten feet long, fastening one end as at E, press the rod gently towards the various protruding tacks; then will this flexible rod or stick conform itself to the curve, and in this position the curve can be readily traced.

The above problem can be applied to circular rooms or windows in which there exists a great variation from the true radius.

Figure 3 illustrates the manner in which it can be applied. According to this problem the space can be more readily and accurately measured and reproduced than the method as shown in Diagram 33, Figure 2, especially if the perpendicular lengths are of considerable length. In this figure, Diagram 33, Figure 2, it will be necessary to erect all the perpendiculars at right angles with the chord or base-line; for should the perpendicular lengths not be given at right angles, the space could not be correctly reproduced. According to this method it requires greater degree of accuracy and considerable more time than in Diagram 34, Figure 3, because here it does not matter if the perpendicular lengths are not given just exactly at right angles with the chord or base-line, as the diagonal length is taken to the point on the circumference to where the perpendiculars are given. In reproducing the figure according to the above method, the tape-line is used in the same manner as you would a compass.

As will be observed, Figures 1 and 3 are divided into a series of triangles, and, as shown in Problem 8, a triangle can be constructed accurately if the three sides are given. Should the depth of the curve be only 1.0 or 1.6, then the perpendicular measurements will suffice, as the tape-line can be placed at right angles with the straight line A C close enough to locate the various points for all practical purposes.

Another method of measuring and reproducing ellipses, ovals, or any irregular circle, is shown in Diagram 35, Figure 1.

In Figure 1, instead of dividing the line A S or B S into a number of equal parts, the circumference is divided or pointed off about 1.0 apart. Then, from the points A S and B S, get the various lengths, as shown by the straight lines. The point S can be located at any convenient place on the circumference. To reproduce Figure 1, locate the points A′ B′ S′, Figure 2, equal to the given distance in Figure 1 in the following manner:

1. Draw an indefinite chalk-line, and upon it mark off 4.0, the distance from A to B. Let the points A′ B′, Figure 2, represent this distance.

2. From the point A′, with a radius of 8.5½, describe an arc at S′.

3. From B′, with a radius of 9.0, describe an arc cutting the former in S′; the points A′ B′ S′ are now established, from which points can be described the various intersecting arcs.

4. From B′, with a radius of 8.9⅜ (this being the distance from B to e, Figure 1), describe an arc in e′.

5. From S′, with a radius of 1.0 (this being the distance from S to e, Figure 1), describe an arc intersecting the former in e′.

6. From B′, with a radius of 8.6⅝ (this being the distance from B to o, Figure 1), describe an arc at o′.

7. From S′, with a radius of 2.0 (this being the distance from S to o, Figure 1), describe an arc intersecting the former in o′.

Continue in this way until all the arcs from S′ to B′ are described. In the same manner describe the

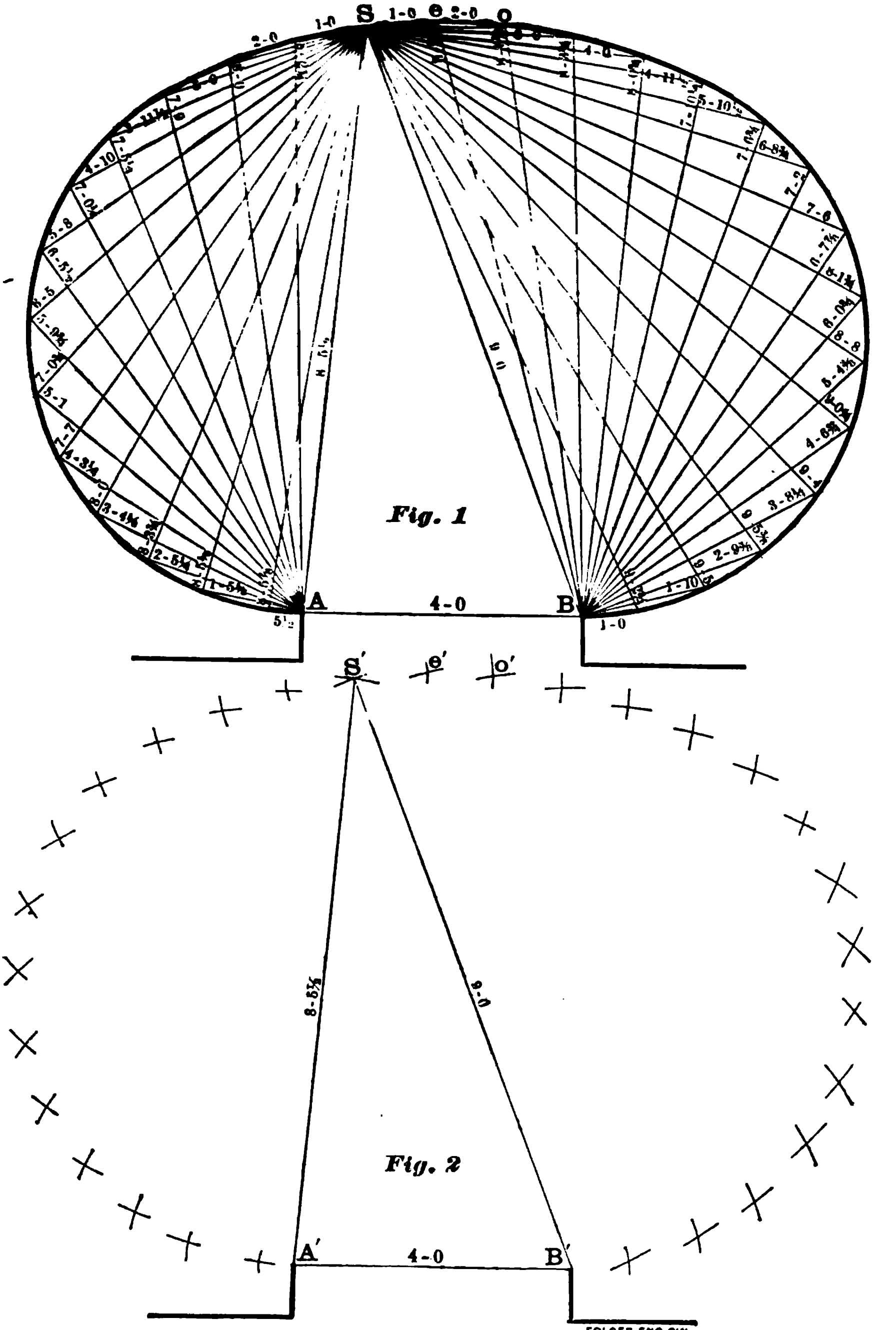


Diagram 35.

various arcs from S′ to A′. After all the intersecting arcs are described, trace the curve as suggested in the preceding diagram.

NOTE.—It will be observed that in this Diagram (35), it will not be necessary to remove the tape-line as often as in Diagram 34; for after marking the various chalk or pencil lines on the skirting of the base-board, and fastening the tape-line in the point S, the various lengths from S to A and S to B can be taken without removal of the tape-line. After these measurements are taken, fasten the tape-line in the point A, and get the various lengths from A to S. Then fasten the tape-line in the point B, and get the different lengths from B to S; also the distance from B to A.

The measurements have been placed in this diagram for the benefit of those who wish to reproduce it. For those who are not conversant with this system, we would advise to reproduce the diagram as explained above; and thus become familiar with its construction.

To draw the various joints or miters when bordering a room, by bisecting the angles.

Let Diagram 36, Figure 1, be a portion of a room, and let A, B, C, D, E, and F be the given points or angles from which it is required to draw the various joint lines of the border, by bisecting the angles.

1. From the point A, Figure 2,* with a radius equal to the distance A B, describe an arc at **h**.

* NOTE.—Figure 2 is a section of Figure 1, drawn to a larger scale, to make plainer the illustration.

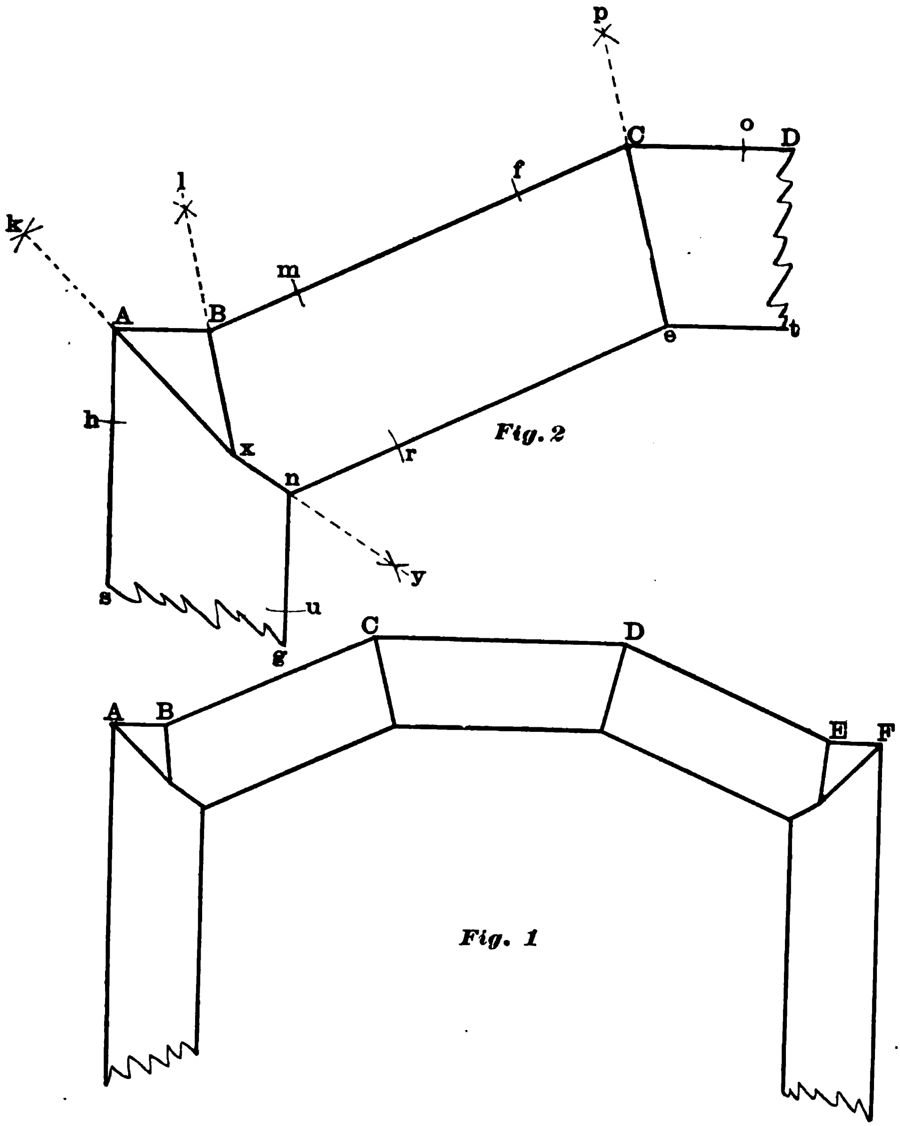


DIAGRAM 36.

2. From the points **h** and B, with any convenient radius, describe arcs intersecting each other in **k**.

3. Through the intersection at **k**, and the point A, draw the straight line **k** A, produced beyond A indefinitely.

4. From the point B, with a radius equal to the distance B A, describe an arc at **m**.

5. From the points A and **m**, with the same or greater radius, describe arcs intersecting each other in **l**.

6. Through the intersection at l, and the point B, draw the straight line l B, produced beyond B, and intersecting the produced straight line **k** A in the point **x**.

7. From the point C, with any convenient radius, describe the arcs **f** and **o**.

8. From the points **f** and **o**, with the same or greater radius, describe arcs intersecting each other in **p**.

9. Through the intersection at **p** and the point C, draw the straight line **p** C, produced beyond C, to the extent of the width of the border, as C **e**.

10. Draw the straight lines **t e** parallel to D C; **e n** parallel to C B; and **g n** parallel to **s** A; then will these straight lines intersect each other in **n** and **e**.

11. From the point **n**, with any convenient radius, describe the arcs **u** and **r**.

12. From the points **u** and **r**, with the same or larger radius, describe arcs intersecting each other in **y**.

13. Through the intersection at **y** and the point **n**, draw the straight line **y n**, produced beyond **n**;

Fig. 1

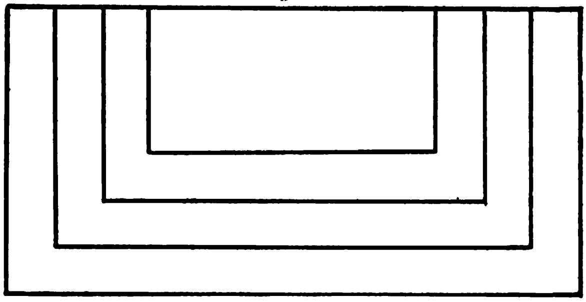


Fig. A

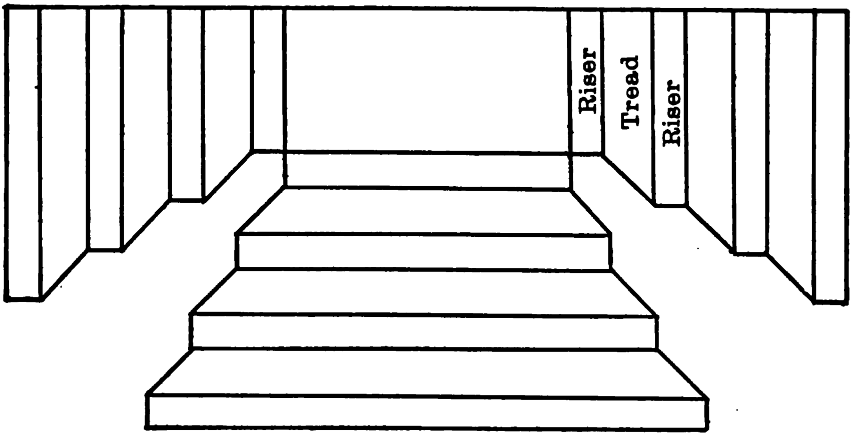


DIAGRAM 37, FIGURE A.

then will this straight line intersect the straight lines A x and B x in the point x. In the same manner the angles at E and F, Figure 1, may be bisected.

NOTE.—This problem of bisecting the angles can be conveniently applied by the "fitter," especially when it becomes necessary to put in "gores," as in the above diagram. The border can be cut and fitted to these lines more readily and accurately than is usually done, and the construction is absolutely correct.

To mark out or describe elevated platforms as they will appear when flattened out.

Diagram 37, Figures 1 and 2 represent elevated platforms, Figure 1 having three treads and four risers; Figure 2 has two treads and three risers. In measuring these platforms, give the extreme length and width of each; that is, the tape-line should follow the rise and tread in the same manner as you would measure a stairway. Figure A shows how Figure 1 would appear when flattened out. In the same manner Figure B shows how Figure 2 will appear.

In order to reproduce Figures A and B, the distances of the outline of the top landing or platform must be given, also the length, width, and height of tread and risers. By a little reflection, Figures A and B will suggest the construction. In cutting and making carpets for platforms of this shape, they are in most instances cut in one piece, and the cutting out of the angles is done by the carpet-layer when laying the carpet. The joints at the various angles should in all cases be sewed together instead of tacking, as this produces the best finish.

Fig. 2

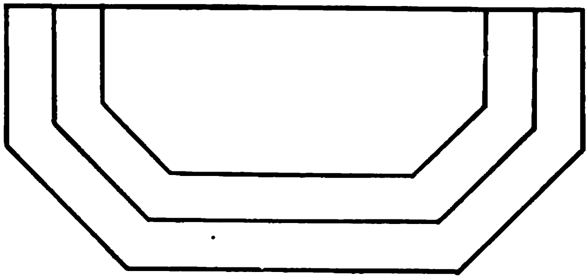


Fig. B

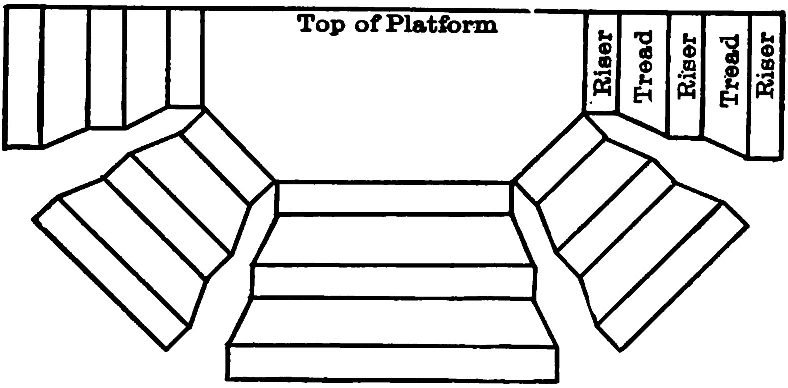


DIAGRAM 37, FIGURE B.

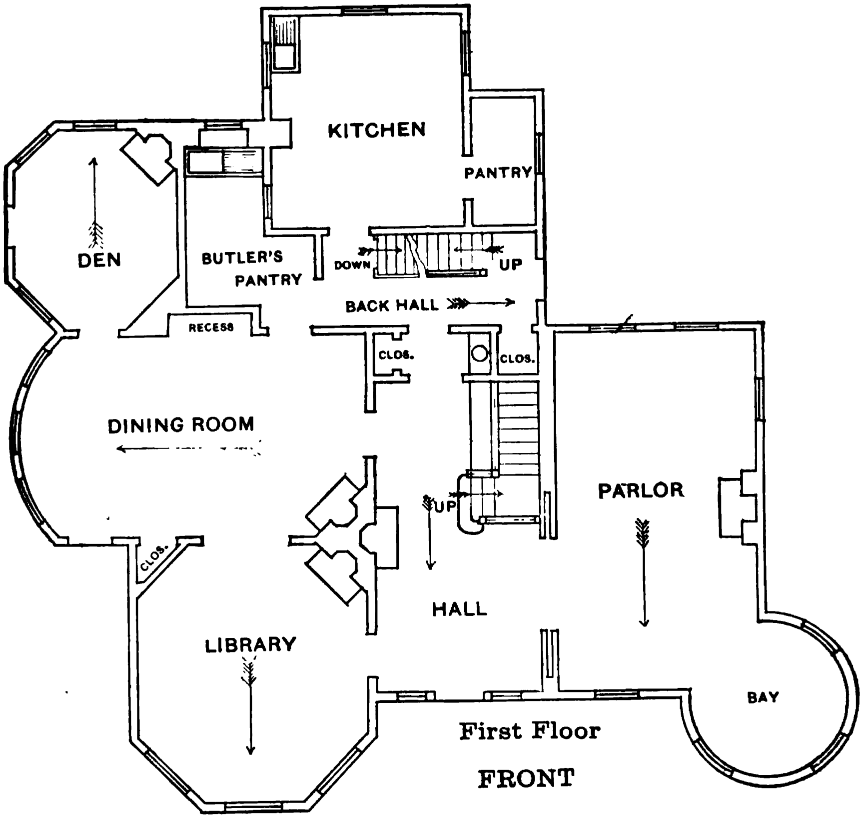
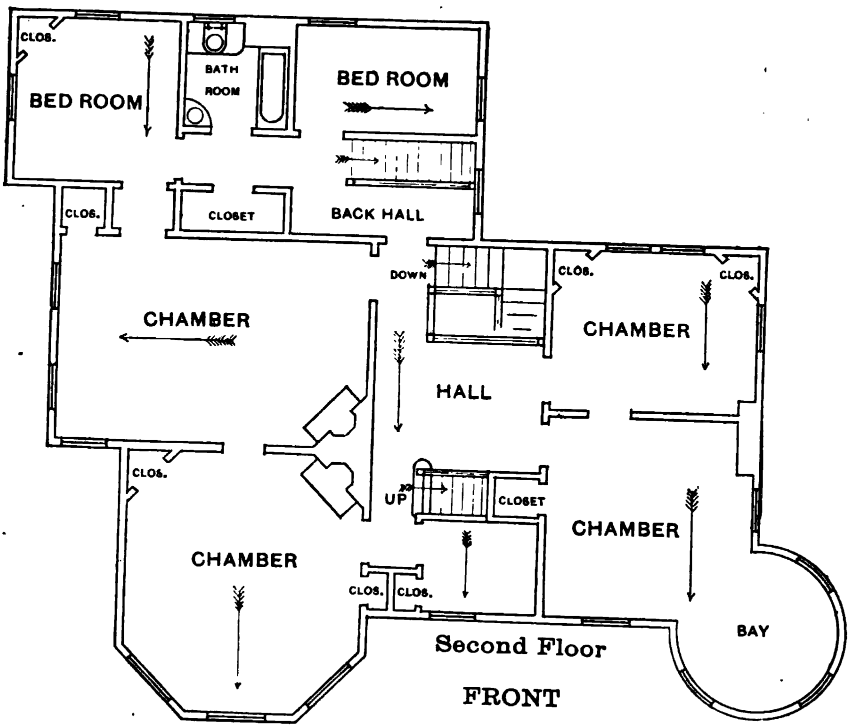
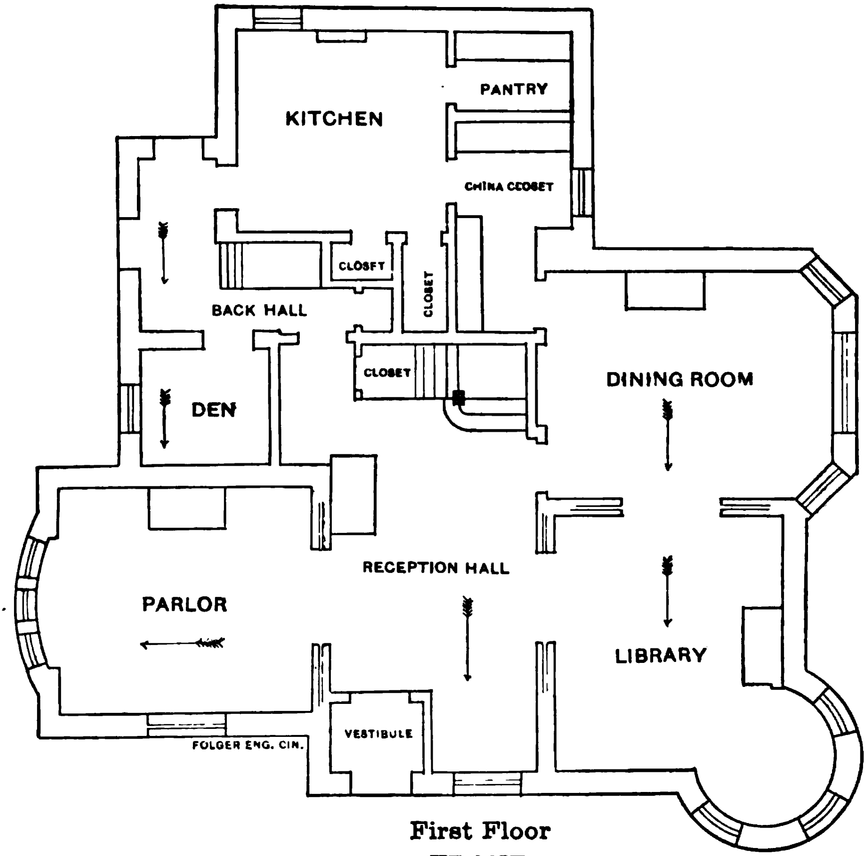

KITCHEN
PANTRY
DEN
BUTLER'S PANTRY
DOWN
UP
BACK HALL
RECESS
CLOS.
CLOS.
DINING ROOM
UP
PARLOR
CLOS.
HALL
LIBRARY
BAY
First Floor
FRONT

DIAGRAM 38.



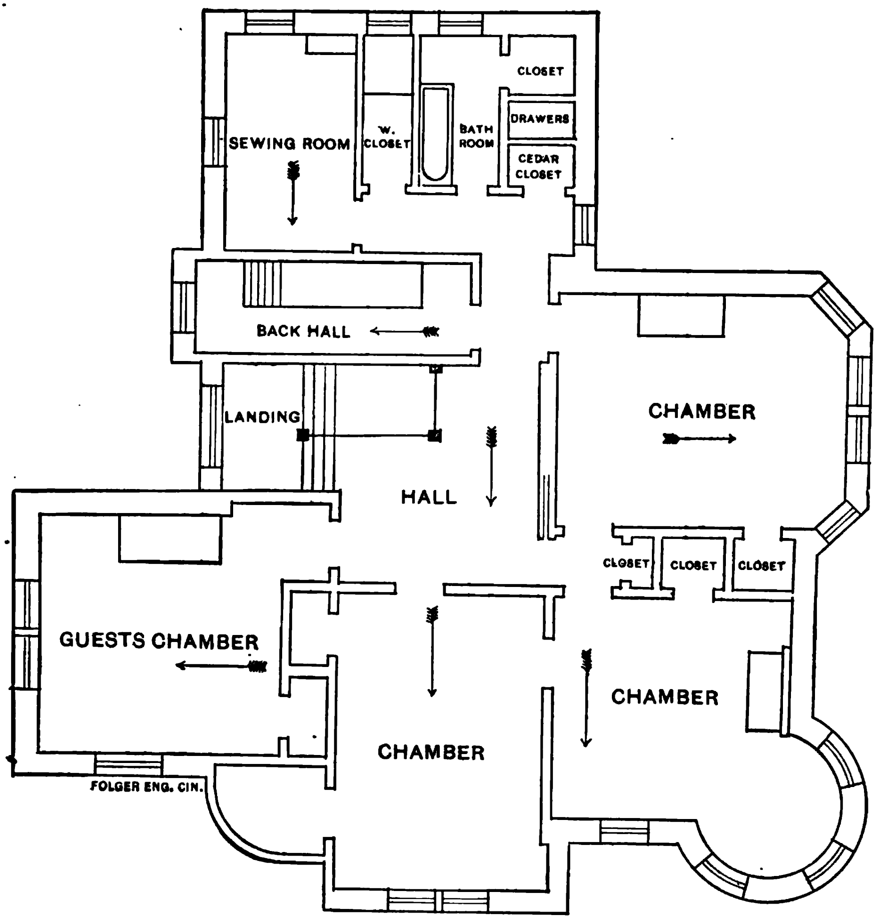
CLOS.
BED ROOM
BATH
ROOM
BED ROOM
CLOS.
CLOSET
BACK HALL
DOWN
CLOS.
CLOS.
CHAMBER
CHAMBER
HALL
CLOS.
UP
CLOSET
CHAMBER
CHAMBER
CLOS.
CLOS.
BAY
Second Floor
FRONT

DIAGRAM 39.



First Floor
FRONT

DIAGRAM 40.



Second Floor
FRONT

DIAGRAM 41.

To find the difference between two unequal quantities, as $\frac{4}{4}$ and $\frac{3}{4}$ or $\frac{4}{4}$ and $\frac{8}{4}$ or $\frac{3}{4}$ and $\frac{5}{8}$, etc.

How many superficial yards will it require of $\frac{4}{4}$ goods to cover a rectangular room 15.0 x 18.0, no allowance made for waste in length or breadth?

Answer. 30 yards.

Operation. 15 feet equals 5 breadths of $\frac{4}{4}$ and 5×18 feet $=$ 90 feet; $90 \div 3 = 30$ yards.

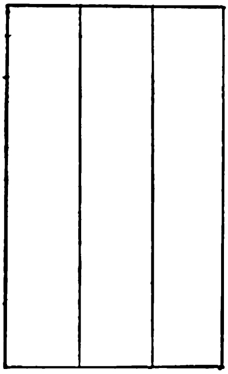


Fig. 1

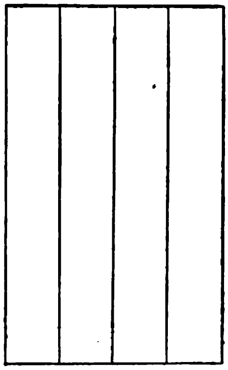


Fig. 2

If it requires 30 yards of $\frac{4}{4}$ width to cover a room 18.0 x 15.0, how many yards will it require of $\frac{3}{4}$?

Ans. $\frac{1}{3}$ more, or 40 yards of $\frac{3}{4}$.

When a room requires, say, 15 yards of $\frac{4}{4}$ goods, it will take $\frac{1}{3}$ more of $\frac{3}{4}$ goods to cover the same area; and if it requires 20 yards of $\frac{3}{4}$ goods, it will take $\frac{1}{4}$ less to cover the same area with $\frac{4}{4}$ goods.

Illustration. Figure 1 is a room 9.0 x 15.0, which will require 3 breadths of $\frac{4}{4}$ goods, as 3 times 36 inches $=$ 9.0 feet; now 3 times 15 feet $=$ 45 feet; 45 feet $=$ 15 yards; as, $45 \div 3 = 15$.

Figure 2 is also a room 9.0 x 15.0, which will require 4 breadths of $\frac{3}{4}$ goods, as 4 times 27 inches $=$ 9.0 feet; now 4 times 15 feet $=$ 60 feet; 60 feet $=$ 20 yards; as, $60 \div 3 = 20$. Hence

it is evident, that it requires $\frac{1}{3}$ more of the $\frac{3}{4}$ width to cover the same area, and $\frac{1}{4}$ less if covered with $\frac{4}{4}$ width.

A short method of determining how much, more or less, it will require according to the difference in the width of goods, or to find what per cent one quantity is greater or less than the other, is to place the denomination of the different quantities in the following manner:

Let it be required to find how much more it requires of $\frac{5}{8}$ than $\frac{3}{4}$ to cover a given area. Reduce the fractions to a common denominator; thus, $\frac{5}{8}$, $\frac{6}{8}$; take the difference between the numerators 5 and 6, which is 1, place this above the numerator 5, and cancel the denominator 8; thus transforming the fraction $\frac{5}{8}$ to $\frac{1}{5}$; then will $\frac{1}{5}$ be the number sought.

OPERATION.

$$\overset{1}{\frac{5}{\cancel{8}}} \quad \frac{6}{8}$$

To illustrate that $\frac{1}{5}$ is the proper answer, suppose we take a room 11.3 x 15, which requires 5 breadths of $\frac{3}{4}$ width, as 5 times 27 inches equals 11.3; then, $5 \times 15 = 75$ feet; 75 feet divided by $3 = 25$ yards of $\frac{3}{4}$. Now, according to the above statement, it will require $\frac{1}{5}$ more, if for $\frac{5}{8}$ width; for $\frac{1}{5}$ of $25 = 5$; $25 + 5 = 30$; or, 30 yards of $\frac{5}{8}$ width.

Verification. For the same size room (11.3 x 15.0), it requires 6 breadths of $\frac{5}{8}$ width, as 6 times $22\frac{1}{2}$ inches equals 11.3; then, 6 times 15.0 equals 90 feet; $90 \div 3$ equals 30 yards of $\frac{5}{8}$ breadth. Should the question be, If it requires 30 yards of $\frac{5}{8}$ width, how much less will it take of $\frac{3}{4}$ width? the answer will be, $\frac{1}{6}$ less. By performing the same operation as explained above, but changing the position of the fractions, and placing the $\frac{6}{8}$ to the left and $\frac{5}{8}$ to the

OPERATION.

$$\overset{1}{\frac{6}{\cancel{8}}} \quad \frac{5}{8}$$

right, $\frac{1}{6}$ will be the answer. For $\frac{1}{6}$ of $30=5$; $30-5=25$; or, 25 yards of $\frac{3}{4}$ width.

General rule for finding the difference between two unequal quantities.

1. Reduce the fractions to the same denomination.

2. If, from the nature of the question, the answer should be GREATER *than the given term, place the greater of the two quantities or numbers on the right, and the* LESS *on the left-hand side; but if the answer should be* LESS, *place the greater quantity or number on the left, and the less on the right-hand side.*

3. Take the difference between the numerators, and place it above the numerator on the LEFT, *and cancel the denominator.*

If it requires 10 yards of $\frac{3}{4}$ matting, how much will it require of $\frac{2}{4}$ width? *Ans.* $\frac{1}{2}$ more, or 15 yards.

According to the above rule, place the greater number on the RIGHT, as from the nature of the question it requires *more* yards of the $\frac{2}{4}$ goods to cover the same area than the $\frac{3}{4}$, and place the less number on the left. Here it will be seen the difference between the numerators is 1. Place this above the numerator 2, and cancel the denominator 4; thus making the fraction $\frac{1}{2}$, one-half.

OPERATION.

$$\overset{1}{\frac{2}{\cancel{4}}}\quad\frac{3}{4}$$

NOTE.—Always place the difference between the two numerators above the numerator on the *left-hand* side.

How much less of $\frac{3}{4}$ than $\frac{2}{4}$? *Ans.* $\frac{1}{3}$.

OPERATION.

$$\overset{1}{\frac{3}{\cancel{4}}}\quad\frac{2}{4}$$

How much more of $\frac{5}{8}$ than $\frac{7}{8}$? *Ans.* $\frac{2}{5}$.

OPERATION.

$$\overset{2}{\frac{5}{\cancel{8}}}\quad\frac{7}{8}$$

How much less of $\frac{6}{4}$ than $\frac{2}{3}$? *Ans.* $\frac{5}{9}$.

Suggestion.—Reduce the fractions to the same denomination,—

$$\frac{\overset{10}{\cancel{18}}}{\cancel{12}}\ \frac{8}{12};\ \frac{10}{18} = \frac{5}{9}.$$

How much greater is $\frac{7}{8}$ than $\frac{2}{3}$?

How much less is $\frac{2}{3}$ than $\frac{7}{8}$?

What difference will there be by using $\frac{7}{8}$ instead $\frac{5}{8}$?

Example.—If it requires 35 yards of $\frac{7}{8}$ width, how much will it require to cover the same area with $\frac{5}{8}$ width?

OPERATION: $\frac{\overset{2}{\cancel{5}}}{\cancel{8}}\ \frac{7}{8}$ *Ans.* $\frac{2}{5}$ more of the $\frac{5}{8}$.

For, if it requires 35 of the $\frac{7}{8}$ width, it will require $\frac{2}{5}$ of 35, which is 14; and $14 + 35 = 49$ yards of the $\frac{5}{8}$ width.

This same principle may be applied to other problems; thus:

If $\frac{3}{4}$ yards cost \$1.20, what will $\frac{5}{8}$ yards cost?

Solution.—Here the answer will be *less*. Then, according to the rule, by placing the greater number on the left, and the smaller on the right-hand side, and performing the operation, $\frac{\overset{1}{\cancel{6}}}{\cancel{6}}\ \frac{5}{8}$, we have $\frac{1}{6}$; that is, $\frac{5}{8}$ will cost $\frac{1}{6}$ less than $\frac{3}{4}$: $\frac{1}{6}$ of 120 is 20; $120 - 20 =$ equals 100. *Ans.* \$1.00.

How many superficial yards of $\frac{3}{4}$ carpet will it require to cover a room 11.3×15.0, no allowance made for waste in either length or width? *Ans.* 25 yards.

If it requires 25 yards of $\frac{3}{4}$ carpet, how many yards will it require to cover the same space with $\frac{3}{4}$ carpet and $\frac{5}{8}$ border? *Ans.* $17\frac{1}{2}$ border, $12\frac{1}{2}$ carpet, or 30 yards carpet and border.

Thus it will be seen that it requires $\frac{1}{5}$ more to cover the same room with border than without. But

this same per cent can not be applied in every instance, as will be apparent by inspecting the following table:

Dimension of rooms, ...	Requires of 4/4, . .	Requires of 3/4, . .	Requires with 5/8 border.		Total yards of carpet and border, .	Amount more with border than without, ...	Cost with 5/8 border and 3/4 carpet per square yard, . . .
			Carpet.	Border.			
11.3 × 15.0	18¾ yds	25 yds	12½ yds.	17½ yds.	30 yds.	⅕	150⅔
15.0 × 15.9	26¼ "	35 "	20½ "	20 "	40½ "	1/7 nearly	146⅔
15.0 × 24.9	41¼ "	55 "	26½ "	35 "	61½ "	1/9 "	140 20/33

In the above table it will be observed that it takes an even number of widths, whether 4/4, ¾, or ¾, with ⅝ border, is used in each of the above rooms, no allowance made for waste. The difference between the 4/4 and ¾ is ⅓ more of the ¾ width in each of the above rooms; but the difference between the ¾ width with border and without, requires ⅕ more in the first room, 1/7 nearly in the second room, and 1/9 nearly in the third room. Hence, it will be evident that we can not strike a uniform per cent when border is required, as we can between 4/4 and ¾ without border; for as the proportion of the room increases or diminishes, the per cent will increase or diminish in the same proportion.

In estimating the quantity of yards approximating, we may employ the method shown in the preceding pages for determining how much, more or less, it requires according to the difference in the width of goods; *but when accuracy is required, it will be necessary to make the calculations according to the shape*

and size of the room, hall, or space to be carpeted, the class of goods to be used, and the amount of waste there will be in matching the pattern.

Should a case present itself where it is requested to submit prices per square yard, *and only* the number of *square yards* the room contains is to be allowed, and if ¾ carpet with ⅝ border is to be used, before complying with this request it will be necessary to know the size and shape of the room, and find how many yards of ¾ carpet and ⅝ border it will require, and how many square yards the room contains, before a price can be fixed. Should there be several rooms, differing in size, and the same class and price of goods are to be used in the various rooms, *for each room there will be a difference in price.*

To illustrate: Suppose we take, for example, the dimensions of the three rooms on the opposite page. The room, 11.3 x 15.0, equals 18¾ square yards, and of ¾ carpet with ⅝ border it requires 12½ yards of ¾ carpet and 17½ yards of ⅝ border. Assuming the price of the ¾ carpet to be $1.00 and the ⅝ border 90 cents per yard, then will 12½ × 1.00 = 12.50, and 17½ × 90 = 15.75; 12.50 + 15.75 = $28.25—the total cost of the carpet and border to cover the room 11.3 x 15.0. This amount must be divided by the number of square yards the room contains, which is 18¾ yards. Then, 28.25 ÷ 18.75 = 1.50⅔. Thus will $1.50⅔ be the price of the ¾ width, with the ⅝ border, should only the number of square yards the room contains be allowed.

Performing the same operation on the two other rooms, and at the *same prices* as quoted above, the room, 15.0 x 15.9, will cost \$1.46$\frac{2}{3}$ per square yard, and the 15.0 x 24.9 room will cost \$1.40$\frac{20}{33}$ per square yard.

Thus it is plain that the price charged for each room will be different, although the carpet and border in each room is figured at the same price. Hence, in determining the price when *only the square yards* the room or space contains is to be allowed, and when $\frac{3}{4}$ carpet and $\frac{5}{8}$ border are to be used jointly, or any other width of border, perform the operation as suggested above.

NOTE.—Usually the $\frac{5}{8}$ border is figured at the same price as the $\frac{3}{4}$ carpet. It will, nevertheless, be necessary to perform the operation as shown above.

PART III.

CUTTING CARPET TO MATCH.

THIS is a question of difficult solution to many beginners. Some have an idea, especially those that deal in carpets to a limited extent, that if they have a room to be covered with Brussels carpet—that is, 14.6 long by 6 widths wide—and the carpet cuts to match—say 16.0, which would be 1.6 longer than the required length—that an experienced cutter could cut the carpet with less waste, which, however, is not the case. For if the pattern cuts say every 2.0 long, it will naturally follow that it will cut at 4 feet, 6 feet, 8 feet, etc., increasing 2 feet at each repetition. It will appear from this that it will also cut fourteen feet and sixteen feet. So, if a room is 14.6 long, it will cut 6 inches short, or 1.6 over the required length; and no cutter, however experienced, can cut the carpet between the points 14.0 and 16.0. So the expert cutter can not get the room of 6 widths by 14.0 long out of any less yards, by cutting from one piece, than the small dealer, with his limited experience.

But here is an advantage that large dealers have over smaller ones. Where the latter have only one or two pieces of the same pattern, the former may have three or four or more to cut from; and, again,

the large dealer may sell the same pattern to different parties at the same time, thus giving him the advantage of cutting two or more rooms together from the same pattern.

Illustration. Supposing one room to be 14.6, and another 16.6 long by 6 widths wide, making together 31.0 long. Then, according to the above size pattern, the carpet will match at 32.0, or 1.0 longer than the required length. By dividing this 1.0 between the two rooms, there will be a loss of only six inches in each room. By cutting the two rooms together it will take 64 yards, as 6 times 32 feet $=$ 64 yards. By cutting each room separate, it will require 68 yards, as 6 times 16 feet $=$ 32 yards; and 6 times 18 feet $=$ 36 yards; $32 + 36 = 68$. Thus it is self-evident that quite a saving will be gained by cutting two rooms together, as indicated above.

Beginners, and especially dry-goods dealers and general stores, that deal in carpets to a limited extent, will find Figures A, B, C, D, E, F, G, H, K, and L, very interesting illustrations, and a guidance and advantage for cutting and matching carpets. These figures are all carpet patterns which have been photographed, and then engraved.

Figure A shows how to arrange the carpet in order to determine the point where the carpet should be cut. Thus, after rolling out the carpet, and having marked off the required length, bring the end of the carpet, as indicated in this figure, to the chalk-mark produced; then move the end along until the figures

FIGURE A.

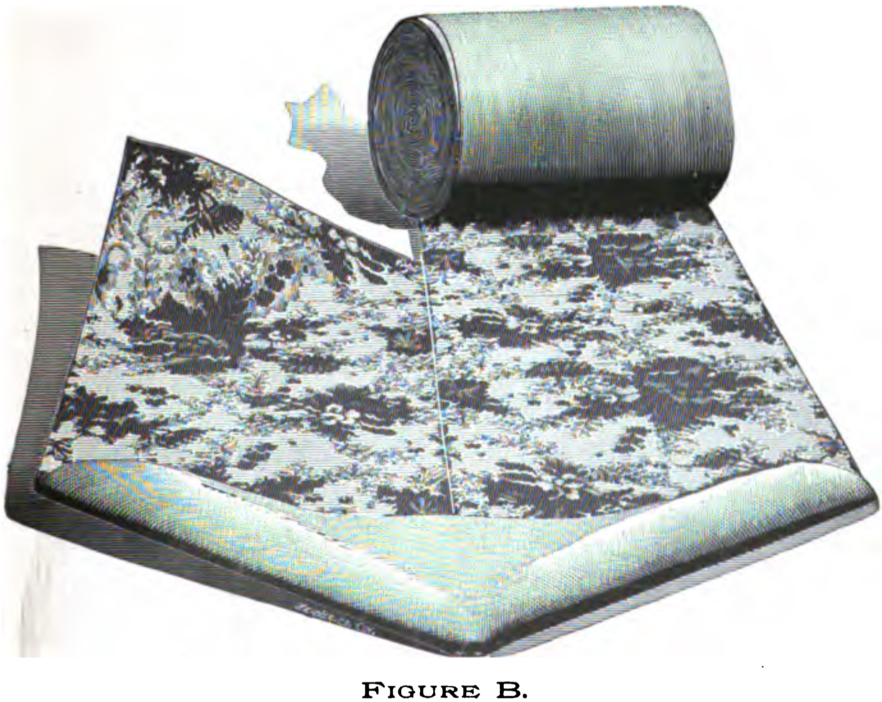


FIGURE B.

match, or to where the figures come opposite each other, if it should be a drop pattern. After having located the proper cutting place, mark this point with chalk.*

Observe carefully, when you take up the end, that you have the figures running in the same direction as indicated by Figure A, and avoid the common error of beginners, as shown in Figure B. It will be apparent, after studying this figure carefully, that it is impossible to locate the matching of the pattern in this manner, for the reason that the pattern or figures do not run in the same direction, but opposite each other.

We would suggest that beginners should, in all cases before cutting, locate the cutting point as shown in Figure A, as this is the best course to determine where the carpet will have to be cut to produce a match. Figure C is commonly called a "drop" pattern, for the reason that the figures "drop" just one half the length of the design in order to produce a match, which causes every alternate width to repeat itself. It therefore has two cutting points, half the distance between the full length of the design, and again where the design is repeated.

Illustration. To make this illustration plain, suppose we have a Brussels carpet, the design of which is, say 2.10 long, and of such character as Figure C, and which is required to be cut for a room 16.6

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* Figure A represents only the manner in which the end of the carpet should be taken up to the chalk-mark, in order to determine the place where the carpet should be cut.

long by 7 widths wide. After rolling out the carpet and marking off the required length (16.6 feet), bring up the end as indicated in Figure A, to determine the proper place where the carpet should be cut, which will be found to be 17.0, as 6 times 2.10 (2.10 being the length of the design) = 17.0. Cut the carpet 17.0, and roll out the second width, making it even, or on a straight line with the first width. Now, what will be the result? It will be found that the carpet will not match, but that the pattern or figures will be opposite each other. What is to be done? By referring to Figure D,* you will be shown how to proceed. After cutting the first width, and making the second width even or on a straight line with the first, cut it through the same figure or design as the first width; and in the same manner cut the third and fourth widths through the same figure. Now

FIGURE C.

*This design is also a drop pattern.

we have four widths, with the designs or figures adjoining each other, none of them being matched; and when in this position they are commonly called a "set." In rolling out the fifth width, draw it beyond the fourth width until it matches, which will be one-half the length of the design. Cut off this surplus length,* and cut the fifth width the same length as the other four. Then, in rolling out the sixth width, and making it even with the fifth, the figures will again come opposite each other, as in the case of the other four widths, except that they will drop one-half the distance between the design. Cut off the sixth width through the same figures as the fifth. In like manner cut off the seventh width. Now we have four widths in one position and three in another, and only one seam that is matched. But by changing the seventh width in the place of the second, the second in place of the seventh, the fourth in place of the fifth, and the fifth in place of the fourth, the whole carpet will be matched, as shown in Figure E. The numbers at the top of Figures D and E will show how the transposition has been effected.

Note.—The design in Figures D and E, which is a Brussels pattern, has been reduced so as to make it come on one page. However, the design is plain enough in our illustration to show that the seams in Figure D, the four widths on the left-hand side, are

* It is advisable to go to the inside end of the roll before wasting the one-half figure on the fifth width, as it sometimes occurs that this inside end will come just right without any waste.

not matched; nor the three widths on the right-hand side, only the seam of the fourth and fifth widths being matched. In Figure E it can be seen that all the seams are matched. The transposing of the widths, as indicated in these figures, is effected in the same manner as if each width had been 27 inches wide, as the length of the design is identically the same in each width; for the design has been decreased proportionally.

It will be observed from the above, that when a drop pattern cuts to a set, as indicated above, and when odd numbers of widths are required, it will take plus one more of one kind; and when even numbers of widths are required, it will take one-half of each kind.

Thus, if 5 widths are required, cut 3 to a set, and 2 drop sets; if 6 widths, cut 3 and 3; 7 widths, 4 and 3; 8 widths, 4 and 4; 9 widths, 5 and 4, etc.

Now, suppose we have a room 15.0 long, and to be covered with the same size design as shown in the preceding illustration,—how would the carpet cut in this case? After marking off the required length (15.0), and bringing up the end of the carpet, as shown in Figure A, it will be found that it will cut to match at 15.7. Why? Because 5 times $2.10 = 14.2$; and $\frac{1}{2}$ of $2.10 = 1.5$; $14.2 + 1.5 = 15.7$. Then, cutting the first width 15.7, and rolling out the second width, and making it even with the first, it will be found to match. Cut the second width the same length as the first. Roll out the third width, and it will match to the second.

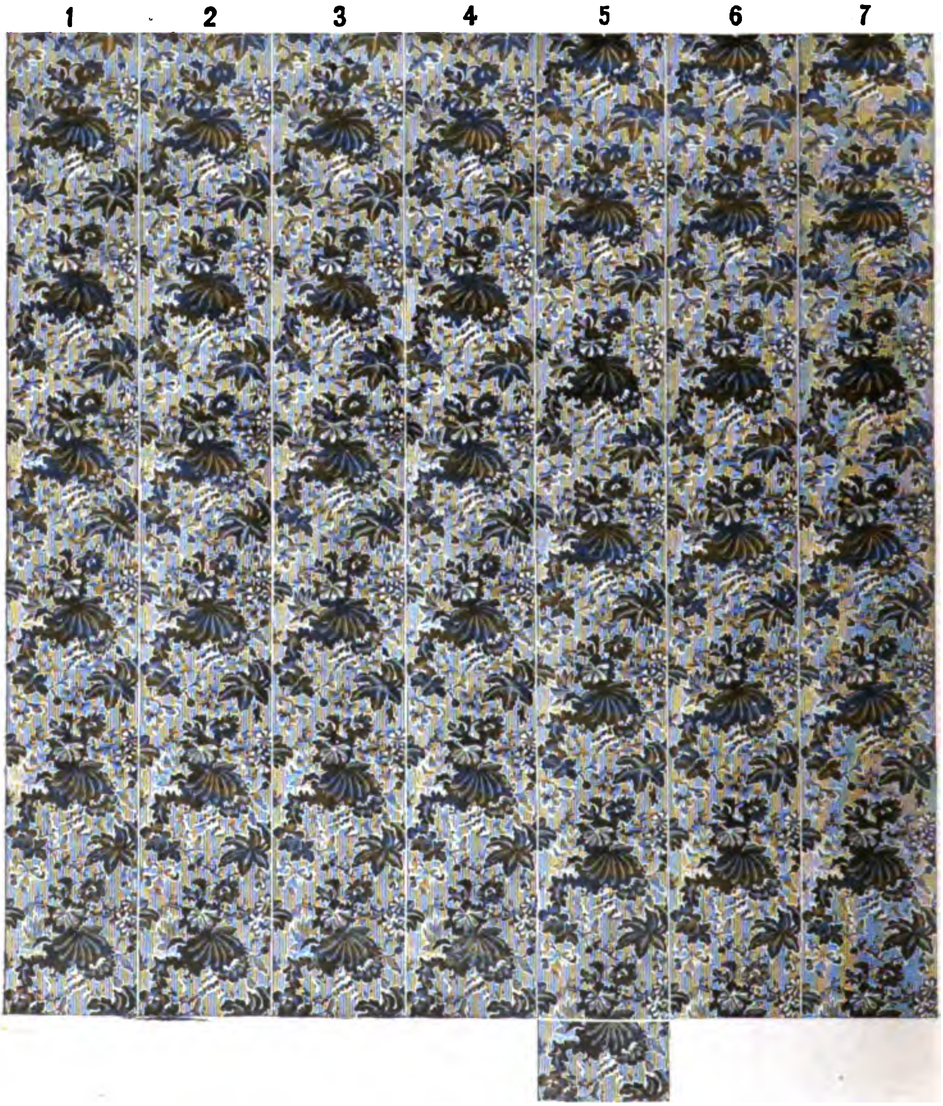

FIGURE D.

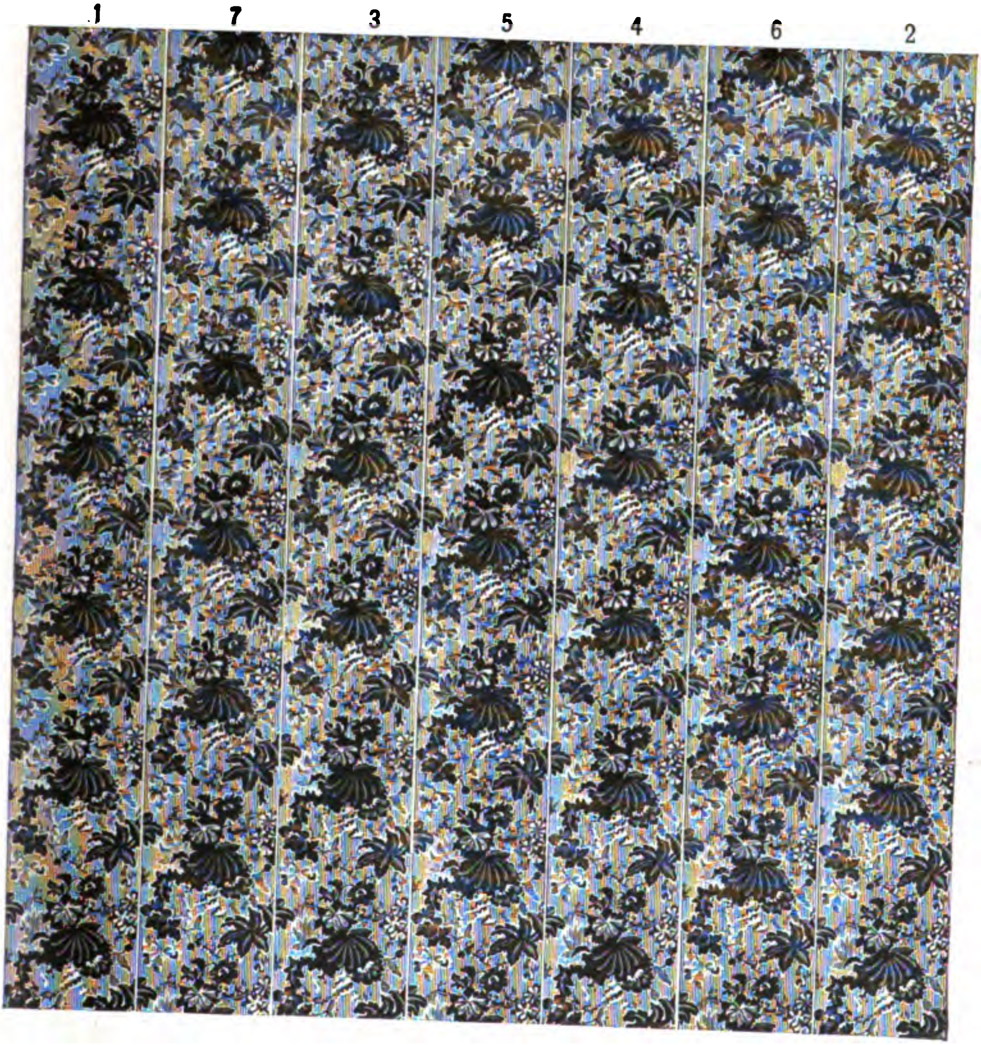

FIGURE E.

Figure D.

FIGURE E.

Continue in the same manner, and each succeeding width will be found to match.

Remember, for "drop" patterns, as Figures C and D, if the length of the design is multiplied by a whole number it will cut to a set. For instance, suppose the length of the design to be 3.6 long,—multiplying this length, say 4 times, will equal 14 feet, and at this point the figure will be repeated; that is, if the carpet is cut at 14 feet; and in rolling out the second width it will be found to be cut through the same figure as the first end of the first width, and the patterns or designs will therefore come opposite each other, as shown in widths 1, 2, 3, and 4, in Figure D. The same result will hold true if taken five times, six times, or any other number of times. But if the length of the design is taken 3½, 4½, 5½, 6½, 7½, etc., times, it will cut to a match. Thus, suppose we take the same length of design as stated before (3.6); then 3½ times 3.6 = 12.3; by cutting the carpet at this point, all the widths will be found to match each other successively. If taken 4½, then will the carpet match at 15.9; if taken 5½, it will match at 19.3, etc. By a little reflection, and with the aid of Figures C and D, the above will be easily understood.

Figures F and G are generally termed "set" patterns, for the reason that the patterns or designs, in order to produce a match, will come opposite each other in every succeeding width. It has, therefore,

FIGURE F.

FIGURE G.

but one cutting point, and that is in the point where the figure or design is repeated.*

Illustration. A room is, say 16.0 long by 11.3 wide, and it is required to cover this room with a Brussels carpet, the length of the design in which is, say, 2.9 long. After marking off this length, bring up the end as shown in Figure A, to determine where it will match, which will prove to be 16.6, as 6 times 2.9 = 16.6. Cut the carpet 16.6; then, in rolling out the second width, and making it even with the first width, the seam will be matched, and every figure will be opposite the one to the other. Cut the second width the same length as the first, and through the same figure; in the same manner cut the third, fourth, and fifth widths. The whole carpet will then be matched, and the design or figures will come opposite each other in every width, as shown in Figure H.†

The designs of many Ingrains are of such a character as shown in Figures F and G. For this reason most Ingrains generally match to a set; that is, each width is cut through the same figure.

Many persons think that the first end of the carpet must be cut through a certain figure in order to produce a match without any loss. This is a mistake.

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* The reader should note the distinction of the term "set," as applied to the above figure, and as described on page 210. When the term "set" is applied to "drop-patterns," it does not imply that the seams are matched, but signifies that the patterns or figures come opposite each other, as shown in Figure D. But when the expression is used that the carpet matches to a "set," it is understood that the patterns or figures will come opposite each other in every successive width, and each seam will be matched as shown in Figure H.

† This design is also a set pattern.

FIGURE H.

Cut the first end of the carpet through what figure you may, the length of the design remains the same. Thus, in Figure C, select any particular point in the design; then from this point get the length to the same point repeated. Now select another particular point in this same design, and get the length to that point repeated, and it will be found that this length is *precisely the same as the first.* The same results will hold true in Figures F and G. It appears from this, that it does not matter through what figure the first end is cut. This applies to all patterns that are not *reversible*, as Figures C, D, F, G, and H.

Figure K is termed a reversible pattern, for the reason that this pattern can be rolled out in either direction in order to match the figures. The figure through which the carpet should be cut, in order to produce a match, is of such an easy solution that it needs no further description. The arrangement as to matching the pattern or figures in carpets generally, is on the same principle as those illustrated here.

There are some patterns in which the figures or design will be repeated only in the 4, 5, or 6 width; but if the above method of matching is thoroughly understood, there will be little difficulty in mastering these patterns. It would not be amiss, however, to suggest the following plan, in order to determine where the design will match. After marking off the desired length, bring up the end as shown in Figure A, and if it should waste much on the right-hand side, try the left-hand side.

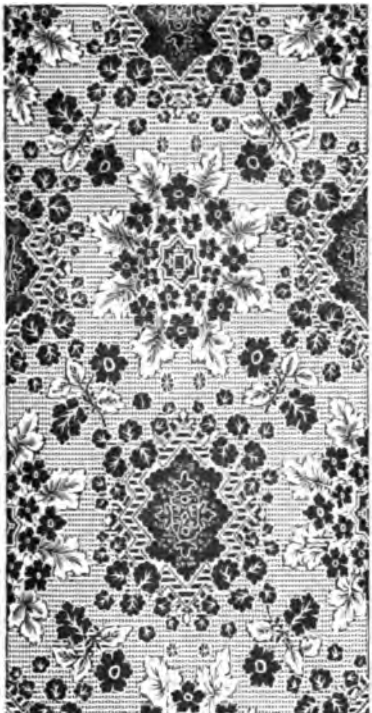

FIGURE K.

FIGURE L.

NOTES ON OIL-CLOTHS AND LINOLEUMS.

IN cutting oil-cloths or linoleums, an allowance from one to two inches will suffice for trimming, and for irregularities which may exist in the base boardings. It would be advisable, after the oil-cloth or linoleum is cut, to spread it on the floor for a few days at least. When wrinkled, it should be spread on the floor for a week or more. In cold weather these articles should be handled carefully; for when exposed in delivery they get hard, and in this condition are as brittle as glass, and easily cracked and broken. The oil-cloth and linoleum should, in cold weather, be delivered to the house at least two days before being laid, and placed in a warm room. Do not set them over a hot-air register, or near a stove, in order to thaw quickly, as this will surely injure the cloth. It is far better to place them in a room of even temperature, and not handle them until thoroughly warmed. In cold weather, when oil-cloth or linoleum is shipped at a distance, or when the customer in-going to lay it himself, put a label on the roll, with proper directions how to handle in cold weather. Do not roll the right side out, as it will be liable to crack the surface. A "sheet" oil-cloth should never be tacked or bradded, except a few at the door, as the cloth will have no chance to stretch. In order to accomplish first-class workmanship, the linoleum should

be stretched on the floor (at store) until the surface is perfectly even, so that, in laying, it will not be necessary to brad it all over to make it lay smooth. The seams should be cemented instead of bradding. In many cases, however, the seams are bradded with satisfactory results.

Sometimes, after the linoleum or oil-cloth is laid, it begins to wrinkle, which would have been greatly obviated had the material been thoroughly stretched before laying. When in this condition, it should be promptly cut and trimmed on the side or ends, as the case may be.

It will be to the interest of both merchant and customer should the salesman, at the time of purchase, request the customer, in case the oil-cloth or linoleum becomes wrinkled, to send notice to the store at once, that a carpet-layer may be promptly sent to do the necessary cutting and trimming. If this precaution on the part of the merchant is not taken, the wrinkled oil-cloth or linoleum is soon broken and ruined, and the customer blames the merchant for selling imperfect goods. In this case the adage well holds, "An ounce of prevention is worth a pound of cure."

TABLE OF CUTTING LENGTHS.

IN order to apply this table, measure the full length of the design, and determine if it is a set or drop pattern. The letters S and M on the marginal side of the table indicate "set" and "match."

In order to make this illustration plain, we will take the following example: Suppose we have a "drop" pattern, such as Figure C, the design of which is, say, 45 inches long; it is required to find, then, how the carpet will cut for a room which is, say, 14.6 long. Following the 45 inch column, we come to 15.0, which is the nearest cutting point. Now, the question arises, Does the carpet cut to a set or match at this point? By following on a horizontal line towards the left-hand side, you come to the letter S, which indicates that it cuts to a set at 15.0.

Suppose we take the same size design (45 inches), how will it cut for a room which is 20.0 long? Following the column of 45 inches, we come to 20.7½, which is the nearest cutting length, and, following in a horizontal line, we come to the marginal letter M, which indicates that the pattern will cut to a match at this length.

Now, suppose we have a carpet that matches to a set, the design of which is, say, 29 inches long,—it is required to find how it will cut for a room which is, say, 14.0 long. Following along the 29 inch column

we come to 14.6, which is the nearest cut. Note particularly for patterns which match to a set, the proper place in this table where the carpet will cut must always be on the line with the letter S; for the reason, already explained in this work, that in set patterns which match to a set, the figures will come opposite each other in each and every width. Therefore the length of the design must be multiplied by a whole number. Thus, if the pattern is 29 inches or 2.5 long, it will cut at 4.10, 7.3, 9.8, 12.1, 14.6, 16.11, etc., increasing 2.5 each time.

It sometimes occurs that two pieces of the same pattern will not measure *exactly* alike, and in some instances the same roll may not measure uniformly, caused by shrinking or stretching; it is, therefore, advisable to make a slight allowance for this discrepancy.

	12 in.	13 in.	14 in.	15 in.	16 in.	17 in.	18 in.	19 in.	20 in.	21 in.	22 in.
S.	9.0	8.8	9.4	8.9	9.4	8.6	9.0	9.6	8.4	8.9	9.2
M.	9.6	9.2½	9.11	9.4½	10.0	9.2½	9.9	10.3½	9.2	9.7½	10.1
S.	10.0	9.9	10.6	10.0	10.8	9.11	10.6	11.1	10.0	10.6	11.0
M.	10.6	10.3½	11.1	10.7½	11.4	10.7½	11.3	11.10½	10.10	11.4½	11.11
S.	11.0	10.10	11.8	11.3	12.0	11.4	12.0	12.8	11.8	12.3	12.10
M.	11.6	11.4½	12.3	11.10½	12.8	12.0½	12.9	13.5½	12.6	13.1½	13.9
S.	12.0	11.11	12.10	12.6	13.4	12.9	13.6	14.3	13.4	14.0	14.8
M	12.6	12.5½	13.5	13.1½	14.0	13.5½	14.3	15.0½	14.2	14.10½	15.7
S.	13.0	13.0	14.0	13.9	14.8	14.2	15.0	15.10	15.0	15.9	16.6
M.	13.6	13.6½	14.7	14.4½	15.4	14.10½	15.9	16.7½	15.10	16.7½	17.5
S.	14.0	14.1	15.2	15.0	16.0	15 7	16.6	17.5	16.8	17.6	18.4
M.	14.6	14.7½	15.9	15.7½	16.8	16.3½	17.3	18.2½	17.6	18.4½	19.3
S.	15.0	15.2	16.4	16.3	17.4	17.0	18.0	19.0	18.4	19.3	20.2
M.	15.6	15.8½	16.11	16.10½	18.0	17.8½	18.9	19.9½	19.2	20.1½	21.1
S.	16.0	16.3	17.6	17.6	18.8	18.5	19.6	20.7	20.0	21.0	22.0
M.	16.6	16.9½	18.1	18.1½	19 4	19.1½	20.3	21.4½	20.10	21.10½	22.11
S.	17.0	17.4	18.8	18.9	20.0	19.10	21.0	22 2	21.8	22.9	23.10
M.	17.6	17.10½	19.3	19.4½	20.8	20.6½	21.9	22.11½	22.6	23.7½	24.9
S.	18.0	18.5	19.10	20.0	21.4	21.3	22.6	23.9	23.4	24.6	25.8
M.	18.6	18.11½	20.5	20.7½	22.0	21.11½	23.3	24.6½	24.2	25.4½	26.7
S.	19.0	19.6	21.0	21.3	22.8	22.8	24.0	25.4	25.0	26.3	27.6
M.	19.6	20.0½	21.7	21.10½	23.4	23.4½	24.9	26.1½	25.10	27.1½	28.5
S.	20.0	20.7	22.2	22.6	24.0	24.1	25.6	26.11	26.8	28.0	29.4
M.	20.6	21.1½	22.9	23.1½	24.8	24.9½	26.3	27.8½	27.6	28.10½	30.3
S.	21.0	21.8	23.4	23.9	25.4	25.6	27.0	28.6	28.4	29.9	31.2
M.	21.6	22.2½	23.11	24.4½	26.0	26 2½	27.9	29.3½	29.2	30.7½	32.1
S.	22.0	22.9	24.6	25.0	26.8	26.11	28.6	30.1	30.0	31.6	33.0
M.	22.6	23.3½	25.1	25 7½	27.4	27.7½	29.3	30.10½	30.10	32.4½	33.11
S.	23.0	23.10	25.8	26.3	28.0	28.4	30.0	31.8	31.8	33.3	34.10

	23 in.	24 in.	25 in.	26 in.	27 in.	28 in.	29 in.	30 in.	31 in.	32 in.
S.	9.7	8.0	8.4	8.8	9.0	9 4	9.8	10.0	7.9	8.0
M.	10.6½	9.0	9.4½	9.9	10.1½	10.6	10.10½	11.3	9.0½	9.4
S.	11.6	10.0	10.5	10.10	11.3	11.8	12.1	12.6	10.4	10.8
M.	12.5½	11.0	11.5½	11.11	12.4½	12.10	13.3½	13.9	11.7½	12.0
S.	13.5	12.0	12.6	13.0	13.6	14.0	14.6	15.0	12.11	13.4
M.	14.4½	13.0	13.6½	14.1	14.7½	15.2	15.8½	16.3	14.2½	14.8
S.	15.4	14.0	14.7	15.2	15.9	16.4	16.11	17.6	15.6	16.0
M.	16.3½	15.0	15.7½	16.3	16.10½	17.6	18.1½	18.9	16.9½	17.4
S.	17.3	16.0	16.8	17.4	18.0	18.8	19.4	20.0	18.1	18.8
M.	18.2½	17.0	17.8½	18.5	19.1½	19.10	20.6½	21.3	19.4½	20.0
S.	19.2	18.0	18.9	19.6	20 3	21.0	21.9	22.6	20.8	21.4
M.	20.1½	19.0	19.9½	20.7	21.4½	22.2	22.11½	23.9	21.11½	22.8
S.	21.1	20.0	20.10	21.8	22.6	23.4	24.2	25.0	23.3	24.0
M.	22.0½	21.0	21.10½	22.9	23.7½	24.6	25.4½	26.3	24.6½	25.4
S.	23.0	22.0	22.11	23.10	24.9	25.8	26.7	27.6	25.10	26.8
M.	23.11½	23.0	23.11½	24.11	25.10½	26.10	27.9½	28.9	27.1½	28.0
S.	24.11	24.0	25.0	26.0	27.0	28.0	29.0	30.0	28.5	29.4
M.	25.10½	25.0	26.0½	27.1	28.1½	29.2	30.2½	31.3	29.8½	30.8
S.	26.10	26.0	27.1	28.2	29.3	30.4	31.5	32.6	31.0	32.0
M.	27.9½	27.0	28.1½	29.3	30.4½	31.6	32.7½	33.9	32.3½	33.4
S.	28.9	28.0	29.2	30.4	31.6	32.8	33.10	35.0	33.7	34.8
M.	29.8½	29.0	30.2½	31.5	32.7½	33.10	35.0½	36.3	34.10½	36.0
S.	30.8	30.0	31.3	32.6	33.9	35.0	36.3	37.6	36.2	37.4
M.	31.7½	31.0	32.3½	33.7	34.10½	36.2	37.5½	38.9	37.5½	38.8
S.	32.7	32.0	33.4	34.8	36.0	37.4	38.8	40.0	38.9	40.0
M.	33.6½	33.0	34.4½	35.9	37.1½	38.6	39.10½	41.3	40.0½	41.4
S.	34.6	34.0	35.5	36.10	38.3	39.8	41.1	42.6	41.4	42.8
M.	35.5½	35.0	36.5½	37.11	39.4½	40.10	42.3½	43.9	42.7½	44.0
S.	36.5	36.0	37.6	39.0	40.6	42.0	43.6	45.0	43.11	45.4

	33 in.	34 in.	35 in.	36 in.	37 in.	38 in.	39 in.	40 in.	41 in.	42 in.
S.	8.3	8.6	8.9	9.0	9.3	9.6	9.9	10.0	10.3	10.6
M.	9.7½	9.11	10.2½	10.6	10.9½	11.1	11.4½	11.8	11.11½	12.3
S.	11.0	11.4	11.8	12.0	12.4	12.8	13.0	13.4	13.8	14.0
M.	12.4½	12.9	13.1½	13.6	13.10½	14.3	14.7½	15.0	15.4½	15.9
S.	13.9	14.2	14.7	15.0	15.5	15.10	16.3	16.8	17.1	17.6
M.	15.1½	15.7	16.0½	16.6	16.11½	17.5	17.10½	18.4	18.9½	19.3
S.	16.6	17.0	17.6	18.0	18.6	19.0	19.6	20.0	20.6	21.0
M.	17.10½	18.5	18.11½	19.6	20.0½	20.7	21.1½	21.8	22.2½	22.9
S.	19.3	19.10	20.5	21.0	21.7	22.2	22.9	23.4	23.11	24.6
M.	20.7½	21.3	21.10½	22.6	23.1½	23.9	24.4½	25.0	25.7½	26.3
S.	22.0	22.8	23.4	24.0	24.8	25.4	26.0	26.8	27.4	28.0
M.	23.4½	24.1	24.9½	25.6	26.2½	26.11	27.7½	28.4	29.0½	29.9
S.	24.9	25.6	26.3	27.0	27.9	28.6	29.3	30.0	30.9	31.6
M.	26.1½	26.11	27.8½	28.6	29.3½	30.1	30.10½	31.8	32.5½	33.3
S.	27.6	28.4	29.2	30.0	30.10	31.8	32.6	33.4	34.2	35.0
M.	28.10½	29.9	30.7½	31.6	32.4½	33.3	34.1½	35.0	35.10½	36.9
S.	30.3	31.2	32.1	33.0	33.11	34.10	35.9	36.8	37.7	38.6
M.	31.7½	32.7	33.6½	34.6	35.5½	36.5	37.4½	38.4	39.3½	40.3
S.	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
M.	34.4½	35.5	36.5½	37.6	38.6½	39.7	40.7½	41.8	42.8½	43.9
S.	35.9	36.10	37.11	39.0	40.1	41.2	42.3	43.4	44.5	45.6
M.	37.1½	38.3	39.4½	40.6	41.7½	42.9	43.10½	45.0	46.1½	47.3
S.	38.6	39.8	40.10	42.0	43.2	44.4	45.6	46.8	47.10	49.0
M.	39.10½	41.1	42.3½	43.6	44.8½	45.11	47.1½	48.4	49.6½	50.9
S.	41.3	42.6	43.9	45.0	46.3	47.6	48.9	50.0	51.3	52.6
M.	42.7½	43.11	45.2½	46.6	47.9½	49.1	50.4½	51.8	52.11½	54.3
S.	44.0	45.4	46.8	48.0	49.4	50.8	52.0	53.4	54.8	56.0
M.	45.4½	46.9	48.1½	49.6	50.10½	52.3	53.7½	55.0	56.4½	57.9
S.	46.9	48.2	49.7	51.0	52.5	53.10	55.3	56.8	58.1	59.6

	43 in.	44 in.	45 in.	46 in.	47 in.	48 in.	49 in.	50 in.	51 in.
S.	7.2	7.4	7.6	7.8	7.10	8.0	8.2	8.4	8.6
M.	8.11½	9.2	9.4½	9.7	9.9½	10.0	10.2½	10.5	10.7½
S.	10.9	11.0	11.3	11.6	11.9	12.0	12.3	12.6	12.9
M.	12.6½	12.10	13.1½	13.5	13.8½	14.0	14.3½	14.7	14.10½
S.	14.4	14.8	15.0	15.4	15.8	16.0	16.4	16.8	17.0
M.	16.1½	16.6	16.10½	17.3	17.7½	18.0	18.4½	18.9	19.1½
S.	17.11	18.4	18.9	19.2	19.7	20.0	20.5	20.10	21.3
M.	19.8½	20.2	20.7½	21.1	21.6½	22.0	22.5½	22.11	23.4½
S.	21.6	22.0	22.6	23.0	23.6	24.0	24.6	25.0	25.6
M.	23.3½	23.10	24.4½	24.11	25.5½	26.0	26.6½	27.1	27.7½
S.	25.1	25.8	26.3	26.10	27.5	28.0	28.7	29.2	29.9
M.	26.10½	27.6	28.1½	28.9	29.4½	30.0	30.7½	31.3	31.10½
S.	28.8	29.4	30.0	30.8	31.4	32.0	32.8	33.4	34.0
M.	30.5½	31.2	31.10½	32.7	33.3½	34.0	34.8½	35.5	36.1½
S.	32.3	33.0	33.9	34.6	35.3	36.0	36.9	37.6	38.3
M.	34.0½	34.10	35.7½	36.5	37.2½	38.0	38.9½	39.7	40.4½
S.	35.10	36.8	37.6	38.4	39.2	40.0	40.10	41.8	42.6
M.	37.7½	38 6	39.4½	40.3	41.1½	42.0	42.10½	43.9	44.7½
S.	39.5	40.4	41.3	42.2	43.1	44.0	44.11	45.10	46.9
M.	41.2½	42.2	43 1½	44.1	45.0½	46.0	46.11½	47.11	48.10½
S.	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0
M.	44.9½	45.10	46.10½	47.11	48.11½	50.0	51.0½	52.1	53.1½
S.	46.7	47 8	48.9	49.10	50.11	52.0	53.1	54.2	55.3
M.	48.4½	49.6	50.7½	51.9	52.10½	54.0	55.1½	56.3	57.4½
S.	50.2	51.4	52.6	53.8	54.10	56.0	57.2	58.4	59.6

	52 in.	53 in.	54 in.	55 in.	56 in.	57 in.	58 in.	59 in.	60 in.
S.	8.8	8.10	9.0	9.2	9.4	9.6	9.8	9.10	10.0
M.	10.10	11.0½	11.3	11.5½	11.8	11.10½	12.1	12.3½	12.6
S.	13.0	13.3	13.6	13.9	14.0	14.3	14.6	14.9	15.0
M.	15.2	15.5½	15.9	16.0½	16.4	16.7½	16.11	17.2½	17.6
S.	17.4	17.8	18.0	18.4	18.8	19.0	19.4	19.8	20.0
M.	19.6	19.10½	20.3	20.7½	21.0	21.4½	21.9	22.1½	22.6
S.	21.8	22.1	22.6	22.11	23.4	23.9	24.2	24.7	25.0
M.	23.10	24.3½	24.9	25.2½	25.8	26.1½	26.7	27.0½	27.6
S.	26.0	26.6	27.0	27.6	28.0	28.6	29.0	29.6	30.0
M.	28.2	28.8½	29.3	29.9½	30.4	30.10½	31.5	31.11½	32.6
S.	30.4	30.11	31.6	32.1	32.8	33.3	33.10	34.5	35.0
M.	32.6	33.1½	33.9	34.4½	35.0	35.7½	36.3	36.10½	37.6
S.	34.8	35.4	36.0	36.8	37.4	38.0	38.8	39.4	40.0
M.	36.10	37.6½	38.3	38.11½	39.8	40.4½	41.1	41.9½	42.6
S.	39.0	39.9	40.6	41.3	42.0	42.9	43.6	44.3	45.0
M.	41.2	41.11½	42.9	43.6½	44.4	45.1½	45.11	46.8½	47.6
S.	43.4	44.2	45.0	45.10	46.8	47.6	48.4	49.2	50.0
M.	45.6	46.4½	47.3	48.1½	49.0	49.10½	50.9	51.7½	52.6
S.	47.8	48.7	49.6	50.5	51.4	52.3	53.2	54.1	55.0
M	49.10	50.9½	51.9	52.8½	53.8	54.7½	55.7	56.6½	57.6
S.	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0
M	54.2	55.2½	56.3	57.3½	58.4	59.4½	60.5	61.5½	62.6
S.	56.4	57.5	58.6	59.7	60.8	61.9	62.10	63.11	65.0
M.	58.6	59.7½	60.9	61.10½	63.0	64.1½	65.3	66.4½	67.6
S.	60.8	61.10	63.0	64.2	65.4	66.6	67.8	68.10	70.0